

ONCE UPON A PLACE: STORYTELLING IN GIS EDUCATION

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ABSTRACT

This paper reports on a case study that aims at examining the effects on student learning of Geographic Information Systems (GIS) by introducing storytelling in teaching/learning activities, such as stories being told to the students, and stories that the students told. After the introduction of storytelling, positive effects on student motivation were observed, as well as demonstration of higher-order learning. Narratives helped students to internalize the learning, especially when the narratives were personal.

Keywords: Storytelling, GIS education, higher order learning, motivation

INTRODUCTION

This paper reports on a case study that aims at examining the effects on student learning of Geographic Information Systems (GIS) by introducing storytelling in teaching/learning activities. The study is located in the Department of Civil Engineering and Surveying at the Cape Peninsula University of Technology in South Africa. Storytelling was introduced as a means to increase motivation and stimulate deep learning.

There has been a surge in interest in the use of storytelling in education, and it has been noted that the delivery of narrative through the use of electronic communication is becoming increasingly popular [17]. In higher education, storytelling has been reported as being an effective pedagogical tool, having the ability to code the knowledge that is being passed on [1]. The combination of the ability of narrative to allow students to take on wider perspectives, its natural emphasis on geography, and its power as a learning tool, makes it particularly well suited to GIS education.

The case study focuses on how storytelling was implemented, how it impacted learning, and how it was experienced by students. It is grounded in the South African GIS and geomatics education context, and does not attempt to form any theory of best practice. Following the interpretive paradigm of social research, it seeks to describe the process and effects of a new intervention – storytelling in the education of GIS.

CONTEXT

The reported intervention took place in two courses, each lasting one semester. The first course was an introductory GIS course, taken by a combined cohort of students, either studying towards a diploma in Surveying, or a diploma in Geographical Information

Science(GISc). The second course was a Spatial Analysis course taken by only the GISc students. Formal GIS education at tertiary level is relatively new in South Africa, with only five higher education institutions offering a qualification in GIS.

The South African social landscape is rapidly changing, precipitated largely by the demise of the apartheid government and the emergence of a fledgling democracy in 1994. The reconciliation of a polarized society, which was officially started off by the Mandela administration, continues to be sought after. A potent example of this was the Truth and Reconciliation Commission, during which many stories of human rights abuses were shared, and formed an important step in the process of political and social change.

The sharing of stories across cultural groups helps people to transcend limited personal paradigms and take on broader perspectives, which help in the formation of wider communities. The method storytelling is as old as South African society itself, and has been the dominant way of transmitting cultural information for many indigenous groups who have extensive traditions of oral storytelling [7].

METHODS OF STORYTELLING

The combination of GIS and storytelling has been reported on [14] but is not as common in GIS education as it is in other disciplines such as history that come from a long tradition of using storytelling as a pedagogical tool. In this study, storytelling was used in two main ways: stories that were told to the students by the lecturer, and stories that the students told. Storytelling was also contained in Participatory GIS research done by the authors, and is briefly described.

Stories that were told to the students

The principal author delivered the lectures and told the stories, and decided to use stories from African history as the main source of content. This was used as a way to educate students about a much-neglected aspect of African heritage, as well as have an overarching, interesting theme to base discussions on. There were stories about numerous important historical figures or events told. This exposure to African history is especially important for South African society, whose collective historical knowledge seems more located in the Global North than its own continent. This bias is common in countries that were colonized at some point in their past. Each story was told through the lens of GIS, and the links to sections in the curriculum were made explicit. Attention was focused specifically on spatial analysis techniques and mapping.

One such story was that of the medieval Moroccan traveler, Ibn Battuta, who was a contemporary of the famous European traveler Marco Polo, and traveled further than he did, but yet is not as well known. Why not? History has favoured the European-Christian over the African-Muslim, and this favouritism was enthusiastically discussed. Some of the GIS functionality that was showcased during the Ibn Battuta story was: overlay analysis (e.g. to see which countries that the River Nile passes through), database queries (e.g. to identify which urban centres that he passed through are now cities containing more than 1 million people), attaching imagery to attribute tables (e.g. to show a picture of the Lighthouse of Alexandria that he observed shortly before it was destroyed by an earthquake), and calculating the total distance that he travelled.

Another way of delivering stories was through pre-packaged videos that contained GIS screenshots or videos of specific analyses being performed. One such video was a documentary-style video about the colonial world of the 1600s. The Ottoman Empire and the European colonial powers were described, their geographical range of influence was shown, and some spatial analysis techniques were incorporated into the story. An old map of the Ottoman Empire was georeferenced and the resulting Ottoman Empire polygon was digitised. This was followed by a polygon-on-polygon overlay to determine which current countries fall within the Ottoman Empire polygon. The sea voyage that Jan van Riebeeck took to the Cape during 1651-1652 was shown and was linked to imagery such as paintings from the period, and sound in the form of music and narration. This video served to provide context to the South African story.

Stories that were told by the students

Students were given the opportunity to construct and deliver their own stories. Two assignments are reported on. For the first assignment, students were asked to create a map of their neighbourhood, which would appear in a history textbook in 50 years' time. They had to submit a page out of the history textbook which contained the map and some explanatory text. This task required creativity, as they had to relate a fictitious future event to themselves and GIS.

This assignment was intended to activate two very different ways of thinking compared to what they were accustomed to: thinking about the narrative, and thinking historically. Having been given the exposure to historical thinking through the story of Ibn Battuta and the story of the colonial world of the 1600s, students were asked to construct a historical narrative. This was a very big epistemological difference that had to be negotiated. A big difference between history and geography is "history's classic mode of communication is narrative, while geography finds its most distinctive expression in the visual, synoptic presentation of evidence in maps" [6]. Being very much closer to geography than history, it was noted that they struggled to ignite their creativity, and present the story from another viewpoint. Many submissions were in the first person and contained a (rather boring) description of their neighbourhood.

For feedback, examples of good student submissions were shared with the class, so as to share the creativity and give ideas on how to link GIS with a story. Differentiation of first-person and third-person narrative was also helpful, giving clarity on how writing techniques are chosen for specific tasks.

The second assignment counted more marks than the first one, and part of its brief was as follows:

You are to tell a story that must be able to be followed on a map, and must contain numerous spatial analysis techniques.

The story might be: Your life story up to now, a trip you have taken, or an analysis of some specific event (in your life or someone else's).

You must do all the analysis. The spatial analysis you use must be incorporated into the story. The spatial analysis and GIS processing contained in the story must, at a minimum, have the following: data capture (e.g. digitizing), database analysis, overlay analysis, and buffer analysis. If you use other types of analysis, you will be awarded extra marks.

Submissions took the form of a video or a PowerPoint presentation. Students were then asked to present their stories in a mini-conference which, in addition to the class, was attended by other invited staff. The difference in the quality of the first and second

assignments was noticeable. In the first assignment, students struggled to be creative, and the demonstrated GIS knowledge was much less than the second. The class had the benefit of hindsight in the second assignment, and had experienced numerous exemplars of GIS and narratives being combined, so an improved performance was expected. Open Source software (e.g. Photostory and Audacity) or software that was available on campus (e.g. Windows Moviemaker), was used to produce their digital stories.

Many stories were very emotive. Some of the stories were about: travels between the family home and university; an almost-fatal accident that left a student with a permanent disability; one student's rural childhood, and his experiences as a herd-boy; the travels of a soccer team and a hockey team in Cape Town; and retracing a memorable road trip by linking photography to a roadmap. All the stories incorporated mapping and spatial analysis, and some did this in very novel and interesting ways. The integration of spatial analysis techniques with their stories indicated an ability to relate knowledge to distant domains, which is one indicator of deep learning. Deeper learning happens in a student who actively engages, reflects or creates knowledge, as opposed to a student who only recalls knowledge. Motivation was also observed to be positively affected.

Storytelling and Participatory GIS

Traditional approaches to flood risk analysis using GIS have often ignored indigenous knowledge of the communities residing in the areas of interest [3]. Storytelling was included in current research projects that use Participatory GIS for informal settlement upgrading. These studies sought to use storytelling for vulnerability analysis in flood-prone informal settlements in Cape Town. In two informal settlements in Cape Town, community members relayed their experiences (in the form of personal narratives) with regard to issues such as exposure to hazards, sanitation and incidences of disease. The experiences were then ranked using a pairwise comparison multi-criteria analysis based on discussions with community leaders, and the vulnerability of each household was mapped [13]. The methodology presented a novel way of using people's personal stories to map vulnerability, and it enabled the community to investigate solutions to their problems. This research was then shared with the undergraduate GIS students, who saw how people's individual stories were converted into attributes in a GIS.

MOTIVATION

In students, motivational and cognitive factors are constantly interacting and influence their learning. The current social cognitive understanding of motivation is that it is a multi-faceted phenomenon, which means that students can be motivated in multiple ways [10]. The effect of storytelling activities on intrinsic motivation was observed. The difference between intrinsic motivation and extrinsic motivation is that extrinsic motivation refers to "the performance of an activity in order to attain some separable outcome, and intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself" [11].

Because the storytelling activities counted towards students' course marks, they would obviously be extrinsically motivated, but intrinsic motivation is more important to stimulate deep learning. One way to encourage intrinsic motivation is to include "catch" and "hold" factors of situational interest in the teaching or learning activities. Catch factors stimulate them by catching their attention, whereas hold factors "are

thought to empower students by making the content meaningful so students view the content as useful, or by encouraging students' involvement in the task" [10]. The catch activities were the interesting stories that were told to them, and the hold activities were their GIS stories which they had to relate to themselves in some way.

HIGHER ORDER LEARNING

There are many instruments and taxonomies of describing levels of learning, such as Biggs' SOLO taxonomy [2], but the modified Bloom's taxonomy was used to identify whether students attained higher levels of thinking about GIS. Bloom's taxonomy is perhaps the best-known taxonomy of learning, and was modified in the 1990s to reflect an updated understanding of learning. It consists of three domains: the cognitive, affective and psychomotor domains. The cognitive domain in the modified taxonomy deals with knowledge and intellectual skills, and the behaviours that students can demonstrate are (from the simplest to the most complex behaviour): Remembering, Understanding, Applying, Analysing, Evaluating and Creating. The more complex the behaviour, the higher the order of learning that is being experienced. Lower-order thinking, linked to learned behaviour or reproductive thinking, "demands only routine or mechanical application of previously acquired information" [9], whereas higher-order thinking is linked to reasoning or productive behaviour, and can be used to solve problems through interpretation, analysis and manipulation of information in ways that may never have been done before. The affective and psychomotor domains, although not fully addressed in this paper, were found to be affected by the blending of narrative with GIS. Empathy, communication skills, valuing diversity and software manipulation skills were some of the abilities positively affected by students in telling their stories with GIS.

EVALUATION OF LEARNING

As part of the final summative assessment of the introductory GIS course, students were asked to explain types of GIS analysis by giving practical examples of how they could be used. Some of the analyses were: query by geometry, database query, overlay analyses (such as point-in-polygon), buffer analysis and network analysis.

It was found that out of 55 students, 18 made reference to the story of Ibn Battuta. This constituted 33% of the total class, a significant number. Those who used the story as a means to explain the underlying analysis techniques exhibited higher order learning, mainly Bloom's Analysing, but also showed lower-order abilities, namely Applying and Understanding. Examples of their answers were:

"If you want to display all the cities Eben Betuta visited when he was travelling through Algeria" (for point-in-polygon analysis); and

"If you want to display all the rivers that are in Egypt" (for line-in-polygon analysis).

Taking the students' misspelling of Ibn Battuta as an opportunity for reflection, the importance of captions or text during the telling of the story was realised. The fact that they had not seen Ibn Battuta's name caused many students misspelling it.

One example of an answer that related buffer analysis to the river Nile was:

“Which land parcels will be affected if the Nile river in Egypt floods its banks by 2km?”

This shows Relational understanding as described in Biggs’ SOLO taxonomy [12] or Analysis in Blooms taxonomy. This higher level of understanding is desired in a GIS graduate.

Interviews were also held with the students with the aim of understanding their experience of the storytelling. After their presentations, the vast majority expressed their appreciation for being given an opportunity to learn new, non-GIS software. Photostory, Audacity and Windows Moviemaker were all learnt to a level where students could produce their own digital stories. Some comments about the digital stories were “it’s cool”, and “I didn’t have stagefright”. One student suggested a possible use in the workplace: “If your boss doesn’t know anything about GIS, you could use Photostory and apply GIS analysis to show your boss about GIS”. Another saw analysis in ways unimagined: “you think that the buffer analysis can only be used for one purpose, and then you see how it could be used in different ways”. In doing their presentations, students exhibited the highest levels of understanding on the modified Bloom’s taxonomy by creating a digital story, and analysing a problem from a new perspective.

BENEFITS OF STORYTELLING TO GIS EDUCATION

In writing down and narrating their stories, students practiced their verbal and non-verbal communication skills. For surveying and GISc students, the ability to present a compelling argument through effective reporting is often given less importance than stating the correct facts in a report. In their future careers, the ability to paint a picture for a manager, communicate a strategy to a client, or inform a colleague of a new development, relies just as much on creative expression as their ability to understand GIS.

Incorporating storytelling into GIS analysis and mapping helped students to visualize complex concepts. Storytelling is a powerful method to remind people of the complexity of the real world, and is useful to capture their attention [18]. By including multimedia, it also provided a richer, fuller learning experience through the incorporation of sounds, images and movement. This stimulated multiple senses and included a strongly emotive experience through their personal stories.[16]. One student said that “it opened up my eyes to see how GIS can be used to research some social issues”.

It has been noted that GIS is changing historical scholarship [6], and GIS provides excellent visual and analytical tools, which benefit history teaching. The combination of GIS and historical scholarship is used more in the teaching *with* GIS, rather than *about* GIS [15]. This is expected, as GIS by nature is an applied technology. In demonstrating practical uses of GIS in GIS education, examples of historical scholarship have not been as popular as town planning, site selection, or environmental applications. Most students appreciated the incorporation of history – one said “the history was interesting, and it was useful in teaching GIS because you can see the GIS capabilities, like linking photos and measuring distances”.

Research in “GIS and society” done in the 1990s noted the potential societal impacts of GIS technology [15]. More recent research looks at how GIS and similar technologies

can either enable community activism or exacerbate existing inequalities and create new forms of exclusion [5]. By being given the opportunity to tell their own stories with GIS, students were given a voice. They curated the audience's experiences of their narratives, and being exposed to each other's narratives allowed them to take part in identity creation. The narratives that were chosen were emotive, personal and important in their life journeys. When exposed to a narrative, they were able to empathise and identify with it, thereby broadening their world outlook.

The issue of what type of graduate we as universities are trying to develop, is an ontological one, and is reflected in current research [4]. The emphasis on the intellect as being of paramount importance is being challenged, and the way that our graduates conduct themselves in the world is now being seen as something universities should think about. Commitment, passion and morality are vitally important aspects of *being* that were not traditionally covered in student learning. Through the telling of African history, and of student stories, an ontological space was opened where issues of heritage, common moral values, common interests, ethics and values were discussed.

CONCLUSION

This paper reports on how storytelling was formally introduced into teaching and learning activities of GIS students. It formed an important part of the total learning experience, by having students engage with it in multiple ways. Motivation was observed to be positively affected, and higher order learning was observed. When students were actively engaged, researching and telling their stories, all the levels of Bloom's taxonomy were observed being demonstrated. What was particularly impressive was the ability to apply GIS to a narrative in new ways.

We are exposed to stories on a daily basis, and they can be turned into powerful learning opportunities if harnessed effectively. The story is not a list of facts, nor does it follow the linear sequence of many university curricula. Its power lies in its ability to make the observer appreciate the complexity of the real world. It allows for the acceptance of contradictions in everyday lives - the hero in a story can have both good and bad qualities, and the listener is more likely to be able to accept this dichotomy because of the context and emotion the story provides.

Narratives help students to internalize the learning, especially when the narratives are personal. The narrative serves as the 'hook' on which to attach the GIS knowledge, and whom of us aren't hooked by a good story?

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