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Teachers' Perceptions of Esri Story Maps as Effective Teaching Tools

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Abstract

The current study explores teachers' perceptions of Esri Story Maps as effective teaching tools. Story Maps are a relatively new web application created using Esri's cloud-based GIS platform, ArcGIS Online. They combine digitized, dynamic web maps with other story elements to help the creator effectively convey a message. The relative ease associated with using and creating a Story Map as well as the simple, non-technical interface makes them ideal for use as an educational technology. Survey data were collected at several teacher professional development events where a total of forty-two participants were introduced to the concept of a Story Map and then given a hands-on demonstration on how to create and use the web application. Analysis revealed that the participants perceived Story Maps to be user-friendly, interactive, and engaging, however, as noted in previous studies several obstacles stand in the way of successful implementation. These include inadequate technology resources at schools, a need for additional training, and a lack of time. We recommend that teacher preparation programs begin using GIS and Story Maps as teaching and learning tools for pre-service teachers and that professional development for in-service teachers focus on the specific pedagogical applications of the educational technology and not just the technical skills required to operate Story Maps.

Keywords: online geographic information systems, story maps, teacher perceptions

Introduction

Storytelling is a fundamental part of human nature. While many people may immediately envision oral or textual stories, a variety of other approaches, including maps, can serve as powerful storytelling mediums. The visual nature of maps makes

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them ideal for communicating spatial stories in ways that engage the reader and bridge linguistic and cultural divides. Recent advances in data availability and digital technologies, including geographic information systems (GIS) and "cloud"-based data storage, have put countless maps in the hands of millions of people and have also revolutionized the way people create and understand map-based stories.

Esri, a globally recognized supplier of Geographic Information Systems (GIS) software, has increasingly been focusing their efforts on developing web-based GIS. With ArcGIS Online, Esri's web-based mapping platform, users are able to easily create, access, and share data, maps, and applications in the cloud. Among the web-applications that have developed from these efforts are Story Maps, which combine digitized, dynamic maps with other story elements (i.e., title, text, legend, popups, and other visuals) to help the creator effectively convey a message. While the actual creation of a Story Map requires some technical ability, Esri designed the interface for non-technical audiences.

Industry professionals as well as many researchers and educators are pushing for more substantial use of GIS in K-12 classrooms as a means to improve the current state of geography education (Esri 2014) and student achievement (Goldstein and Alibrandi 2013). Although it may help students learn geographic content and develop spatial thinking skills while utilizing real-world applications, incorporating GIS into an existing curriculum requires the dedication of a significant amount of time and effort by the teacher and administration (Kerski 2003; Baker 2005; Meyer et al. 1999). In addition to learning a new technology, teachers must find the time and desire to incorporate GIS into their existing curricula as well as develop new lesson plans featuring GIS. In an educational realm dominated by high-stakes testing and scripted curricula, teachers are increasingly restricted in terms of time and creativity (Brand and Triplett 2012). The idea of incorporating a complicated educational technology into a curriculum that is already stressed for time may receive a cool reception by educators. If the GIS technology was approachable, however, and allowed teachers to collaborate while meeting standards across subjects, perhaps teachers would be more willing to pursue a novel teaching method, an approach recently tried elsewhere (Hong 2014; 2015). As such, teachers' perceptions of Story Maps are of the utmost importance; without clear benefits and curriculum relevance, demonstrated ease of construction, and enthusiastic support, teachers are unlikely to employ this new educational technology.

Educational technology refers to "a combination of the processes and tools involved in addressing educational needs and problems, with an emphasis on applying the most current tools: computers and other technologies" (Roblyer 2006, 9). Educators striving to meet the needs and better the learning outcomes of their students must consider the characteristics that define the current student population. Commonly referred to as "digital natives", students in many of today's classrooms have never known a world without computers and the internet (Prensky 2001). Consequently, educators, information technology specialists, and a host of other involved parties are seeking more information about functional and accessible educational technologies as well as

the means by which these technologies are successfully implemented. The incorporation of geographic information systems (GIS) in K-12 classrooms is increasingly viewed as a means to promote spatial thinking skills and geographic knowledge (Bednarz 2004). The current educational consensus urges educators to pursue inquiry-based instruction where students construct their own knowledge through student-led research and real world experiences (NGSS 2013). GIS is a natural fit for constructivist learning environments as it urges students to think critically, use real-world data, and connect the analyses to their own communities. GIS is predominantly used in geography and physical science classrooms, but it can also support lessons in history, social studies, language arts, and mathematics, among other subjects (Baker et al. 2012).

The benefits of using GIS in K-12 classrooms aside, the paucity of teachers utilizing GIS may be due to barriers in its adoption and implementation within K-12 classrooms, including a lack of training for educators, a shortage of time to prepare lessons that integrate GIS, and the complexity of the software (Kerski et al. 2013). Learning the software, maintaining adequate information technology (IT) support, finding time in an already segmented school day schedule to teach complex lessons, developing relevant instructional materials, and garnering support from the administration are also challenges that impede the adoption and implementation of GIS by K-12 educators (Baker 2005; Audet and Paris 1997; Meyer et al. 1999; Bednarz and Audet 1999; Bednarz and Ludwig 1997).

Many of the challenges that have been identified pertain to the use of desktop GIS. The recent development and implementation of web-based GIS, although not heavily studied, may be gradually alleviating some of the concerns, especially as Internet access in schools is no longer a novelty. Whereas desktop GIS requires substantial support from IT staff to update operating systems, install the latest version of the costly GIS software, and maintain a seamless network system, web-based GIS only requires a functioning computer with high-speed internet access and adequate bandwidth. Although there are challenges to using this method, Baker (2005) found that less time, commitment, and energy was required to learn web-based GIS; in addition, the simpler functionality and interface was better suited for K-12 classrooms as desktop GIS has a number of advanced tools and functions that are only utilized by professionals.

The frameworks for technology acceptance and adoption are rooted in the concept of self-efficacy, which suggests that the strength of an individual's beliefs concerning their competence in a particular area or ability to reach a goal strongly influence their behavior, choices, and likelihood of success (Bandura 1977). Relating this concept to the current research, an educator with a higher level of self-efficacy regarding GIS as an educational technology may be more likely to adopt and implement the technology in their classroom. As is the case with most instructional technologies, teacher acceptance and enthusiasm governs the degree to which new teaching methods are incorporated into an existing curriculum (Guskey 1986). Teachers, often weary of change, will not accept and implement new technologies and teaching methods, including GIS, if the reward to investment ratio is too low. In other words, if it takes too much time and

effort to learn the new technology and incorporate it into existing lesson plans, and if the interdisciplinary benefits are not clearly defined and explicitly demonstrated, teachers will not invest the necessary resources for successful implementation (Baker et al. 2012). As K-12 education is increasingly dominated by standards-based lessons, it is imperative that the curriculum relevance of GIS teaching tools is demonstrated during professional development events (McClurg and Buss 2007).

As more educators are realizing the interdisciplinary value of ArcGIS Online and Story Maps in classrooms, both at the K-12 and university-levels (Duke 2013; Esri 2013), it is necessary to design a study that assesses the extent to which teachers perceive Story Maps as effective teaching tools. Furthermore, we need to identify the challenges related to creating and using Story Maps and the associated threshold at which teachers will build or encourage their students to build their own Story Maps for unique lesson plans and projects. This research also fills several of the research gaps and recommendations identified by The Road Map for 21st Century Geography Education Project (Edelson et al. 2013).

The Purpose of study

Several studies have examined the educational use of desktop GIS, while relatively few studies have considered web-based GIS applications. Additionally, studies often focus on student learning as opposed to teacher reception. Using a three-part survey (see Appendix), this research aims to answer the following questions:

(1) What are teachers' perceptions of Esri Story Maps as effective teaching tools?

(2) What are the challenges associated with creating and using a Story Map in a K-12 classroom?

Method

Participants

The participants were 27 K-12 teachers and 15 informal educators. Each taught courses varying from English and Government to Environmental Science and World Geography. All grades levels were represented, with the majority (25) teaching grades 7-12. Survey data was collected at four workshops, one each for Advanced Placement Human Geography, an environmental education association, a general geography conference, and a small event for pre-service teacher candidates. Each workshop session lasted approximately 2 hours. The participants chose to attend the training sessions on their own from a series of topical sessions available.

Training Sessions

Each workshop was conducted in a similar manner with participants at their own computer workstations. Workshop participants were first asked about their prior knowledge of geographic information systems (GIS) and then introduced to the concept of a Story Map with a short PowerPoint presentation. Each participant received a tutorial document for reference as they constructed their own Story Map similar to the example constructed beforehand (Figure 1). A variety of questions, concerns, and ideas were posed and discussed throughout the hands-on demonstration, and participants were encouraged to keep note of their thoughts and transcribe them on the subsequent survey. The tutorial took participants through the process of uploading photos to a photo-sharing site, creating a public account on ArcGIS Online, creating a web map and adding data layers, sharing that web map as a Map Tour Story Map, using the interactive builder to incorporate photos and text into the map, populating the metadata, and viewing the final application.

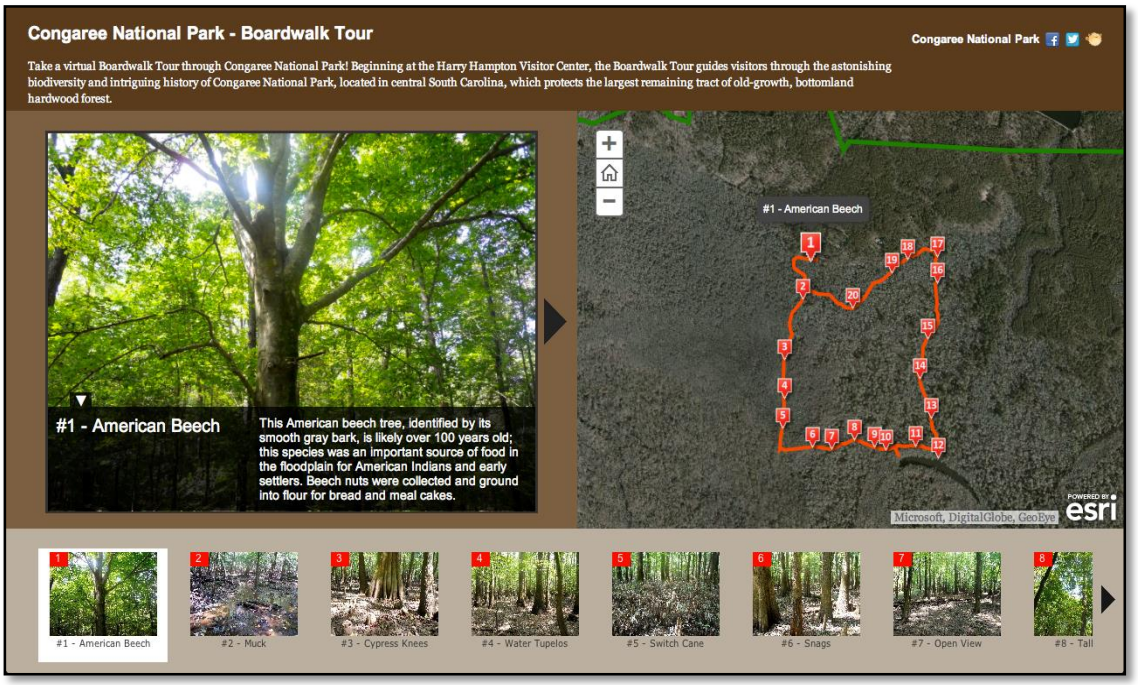

Figure 1.
Screen capture of Story Map created for workshop training sessions, the nature boardwalk for Congaree National Park, South Carolina, United States

Instrument

The survey was composed of three distinct sections. Section one gathered profile data about the participant including their age, the number of years they have been teaching, the current grade level(s) taught, and the subject(s) they are teaching. In addition, participants were asked to choose a response of low, medium, or high for their comfort level teaching with technology, the level of technical support available at their school,

and their level of experience with geospatial technologies. Section two related to the *use* of Story Maps and was composed of six statements with Likert-like responses and two short response questions. The scaled items pertained to the ease of use, interactive and engaging nature, and predicted student enjoyment of Story Maps as well as the educators' thoughts on the potential to use them to meet academic standards and present interdisciplinary material. A final item aimed to determine educators' propensity for collaborating with colleagues to use Story Maps as a teaching tool. The short response questions asked educators to record their likes and dislikes regarding the *use* of Story Maps and to note potential ways in which they would use Story Maps in their own classrooms. The third section of the survey, composed of seven statements with Likert-scale responses and two short response questions, sought to identify the challenges associated with *building* Story Maps and to gauge the threshold for educator buy-in. The scaled items pertained to the ease of navigation within ArcGIS Online, the simplicity of creating a web map, and the level of enjoyment when building a Story Map with the interactive builder. In addition, other items determined educators' propensity for using either pre-made or custom built Story Maps in their classrooms, students' capabilities to create Story Maps, and the increased likelihood of using Story Maps in the classroom pending an additional professional development workshop. The short response questions asked educators to record their likes and dislikes concerning the *creation* of Story Maps as well as perceived obstacles that would limit their ability to use Story Maps in their classrooms.

Analysis of data

Forty-two surveys were collected from the workshop participants. Profile data from section one of the survey (age, number of years teaching, current grade level(s) teaching, current subject(s) teaching) were recorded as written by the participants. The ages ranged from 21 to 66 years old, with an average of 40 years. The number of years teaching ranged from 0 (pre-service) to 30, with an average of 14 years (eight respondents did not answer). Grade levels taught ranged from grade 2 to adult, but twenty (61%) taught grades 9-12 (nine did not answer). Most were teaching World Geography, World History, Environmental Studies, or another social studies course (psychology, economics).

Regarding their comfort level teaching with technology, the level of technical support available at their school, and their level of experience with geospatial technologies, a response of "low", "medium", or "high" was recorded as a score of 1, 2, or 3, respectively. In sections two and three of the survey, responses to the Likert-like items were entered as five options from "Strongly Disagree" up to "Strongly Agree". All responses to the four open-ended questions were transcribed exactly as written by the participants.

A Technology Profile Analysis grouped participants into categories and compared their responses to the scaled items based on their self-reported comfort level teaching with technology, level of technical support available at their school, and level of

experience with geospatial technologies. An Age Analysis analyzed responses between participant categories based on age, and an Education Type Analysis examined responses with regard to the participant's role either a formal or informal educator. The written responses to the open-ended questions were evaluated and grouped into identified themes corresponding to each question.

The Technology Profile Analysis was loosely inspired by the Diffusion of Innovations Theory, which documents the stages of innovation adoption and classifies individuals into adopter categories based on their degree of innovativeness (Rogers 2003). Participants were placed into three groups based on the scores of their technology profile statements: 1) the Enthusiast group (score = 8-9; n=4), 2) the Pragmatist group (score = 5-7; n=31), and 3) the Laggard group (score = 3-4; n=7). The Enthusiast group comprised a relatively small portion of the total sample population, but the data garnered from this group was still very valuable because it represents the most innovative educators who serve as leaders in their schools concerning the incorporation of educational technologies such as GIS. Slightly changing the score ranges (e.g., score range of 7-9 for Enthusiasts) would not appreciably affect the results.

The Age Analysis placed surveys into one of three groups based on their self-reported age. Groups were created for ages 21-30 (n=14), ages 31-50 (n=17), and ages 51 and older (n=11).

The Education Type Analysis compared survey responses between a traditional classroom teacher group composed of elementary, middle, and high school educators and an informal educator group who usually taught outside of a formal classroom setting such as a museum or park.

The descriptive statistics for each of these groups and categories as they relate to the research questions is addressed in the following sections.

Findings

Teacher Perceptions

The Technology Profile, Participant Age, Education Type, and Content Analyses provided a variety of lenses through which to examine the data and therefore afforded a wealth of valuable findings. In this section we report on research question one and its sub-questions:

(1) What are teachers' perceptions of Esri Story Maps as effective teaching tools?
   a. Are Story Maps viewed as an enhancement to existing instruction?
   b. If so, are Story Maps viewed as having interdisciplinary applicability?
   c. If so, are teachers willing to work collaboratively with others to create interdisciplinary Story Maps?

1a: An Instructional Enhancement?

Ninety-five percent of the participants chose Agree or Strongly Agree in response to the item "Story Maps are user-friendly" (n=41). Similarly, 98% of the participants chose

Agree or Strongly Agree regarding the item "Story Maps are interactive and engaging" (n=42). Few substantive differences in responses among subgroups to these two items were found within the Technology Profile, Participant Age, or Education Type Analyses.

Concerning the item "My students would enjoy using Story Maps" (n=39), 87% of the participants chose Agree or Strongly Agree. When examined by Education Type (Informal n=12), 92% of the Informal group picked Agree or Strongly Agree. These educators, who do not necessarily interact with students within a formal classroom and may not teach on a regular basis, still believed that students would enjoy using Story Maps. The Technology Profile Analysis revealed that, when divided into the three groups based on the technology profile statements, the Laggard group was more likely to express neutral sentiments regarding the potential for their students to enjoy using Story Maps. Comparatively, none of the Enthusiasts and only 7% of the Pragmatists chose Neutral, while 75% of the Enthusiasts and 67% of the Pragmatists chose Strongly Agree (Figure 2).

When prompted with the item "Story Maps can help me better present material that meets academic standards" (n=40), 85% of the participants selected Agree or Strongly Agree, an indication that both formal and informal educators see the potential for Story Maps to serve a role in today's standards-based classrooms.

The Content Analysis of the open-ended questions provided additional insight into the teachers' views of Story Maps as an enhancement to existing instruction. When asked about their likes and dislikes concerning the use of Story Maps, participants provided comments such as:

> *"This is a great way to make learning interactive."*
>
> *"Much more user friendly than some of the other GIS software I've seen."*
>
> *"Highly interactive and easy to use; relevant to any profession or teaching application."*

A general overview of all responses (n=59) is shown in Table 1.

When asked about their plans for using Story Maps in the classroom, participants provided ideas such as:

> *"I can see adding them as part of PowerPoint lectures much like video downloads. I can also see using them as a project base for my students to create on the current subject being discussed."*
>
> *"I assist teachers in developing outdoor classrooms, nature trails, public gardens, and see story maps as useful for all these venues."*

An overview of these responses (n=55) is shown in Table 2.

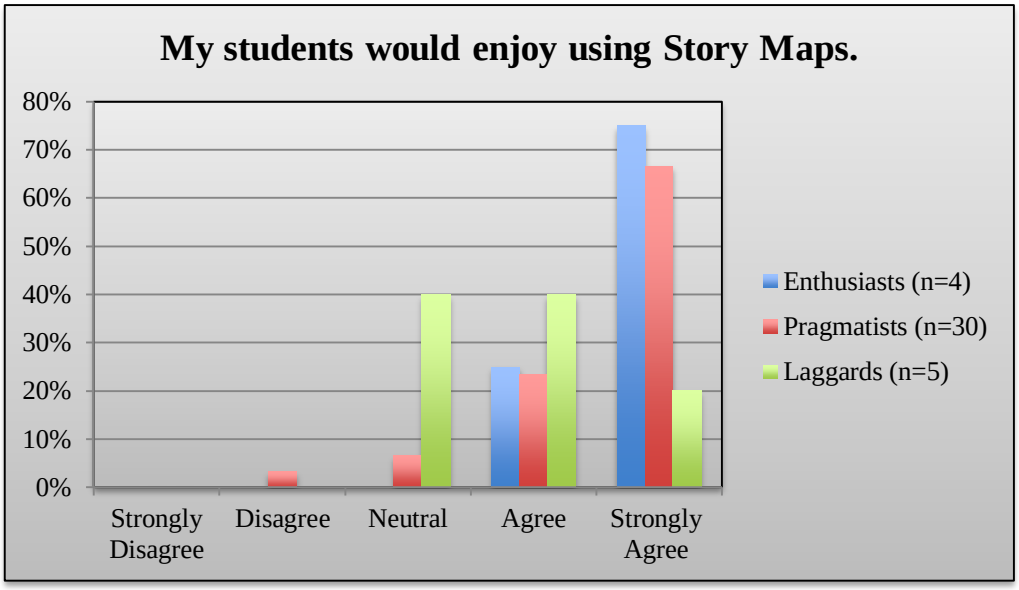

Figure 2.
Technology Profile survey responses to "My students would enjoy using Story Maps."

Table 1.
Likes and dislikes concerning the use of Story Maps

Question	Identified Themes	% of Total Responses
Additional thoughts about what you did or did not like about *using* Story Maps?	Generally positive	20%
	Easy/simple	19%
	Applicable to K-12 and beyond	17%
	Time consuming	12%
	Engaging and interactive	12%
	Like multimedia inputs	8%
	Generally hesitant	7%
	Difficult without technical experience	5%

Table 2.
Plans for using Story Maps in the classroom

Question	Identified Themes	% of Total Responses
How would you plan to use Story Maps in *your* classroom? (i.e.: specific topic, subject, lesson, student projects)	Lectures/presentations	36%
	Student projects	25%
	Outreach/web content	24%
	Use pre-made Story Maps	9%
	Use for non-tested areas	4%
	Unsure	2%

Overall, the participants responded favorably and felt that Story Maps were user-friendly, interactive and engaging, enjoyable for students, and able to help in presenting material that meets academic standards. Although concerns began to emerge related to time and technology use, participants provided positive feedback and generated many ways in which they could use Story Maps in their classrooms. These results indicate that the participants feel that Story Maps could enhance existing instructional methods.

1b: Interdisciplinary Potential?

Although the majority of participants feel that Story Maps could enrich existing instruction, it was critical to uncover their views of Story Maps as having interdisciplinary applicability. Interdisciplinary teaching methods may require increased time and cooperation from educators, but they provide a more practical and engaging education for students. Regarding the item "Story Maps could be used to present material from a variety of subjects (i.e., interdisciplinary) (n=42), all participants chose Agree or Strongly Agree, with 79% choosing Strongly Agree. Few substantive differences in responses among subgroups to these two items were found within the Technology Profile, Participant Age, or Education Type Analyses. This finding supports the use of geospatial technologies such as Story Maps as an interdisciplinary tool in many kinds of classrooms. Where geography has often lost ground as a stand-alone subject, Story Maps can serve as a tool to make sure that geographic concepts and spatial thinking remain alive within the curriculum even when they are not explicitly part of a geography course.

1c: A Chance To Collaborate?

Constructing interdisciplinary teaching materials, such as Story Maps, requires cooperation amongst multiple educators. Participants were therefore prompted with the item "I would collaborate with fellow teachers to use Story Maps as a teaching tool"

(n=40). Encouragingly, 98% of the participants chose Agree or Strongly Agree (Figure 3).

Overall Findings for Research Question One

Given the survey feedback and responses to the open-ended questions, the participants expressed an overwhelmingly positive perception of Story Maps as effective teaching tools. This new web application was viewed as user-friendly, engaging and interactive, and potentially enjoyable for students. Furthermore, the participants affirmed that Story Maps could be used to present standards-aligned materials as well as collaborative, interdisciplinary lessons. Participants praised the simplicity and multimedia capabilities of Story Maps and began brainstorming ways in which they could be used in the classroom. However, the participants also identified a number of obstacles which may hinder the adoption and implementation of Story Maps by educators. These are presented in the following section.

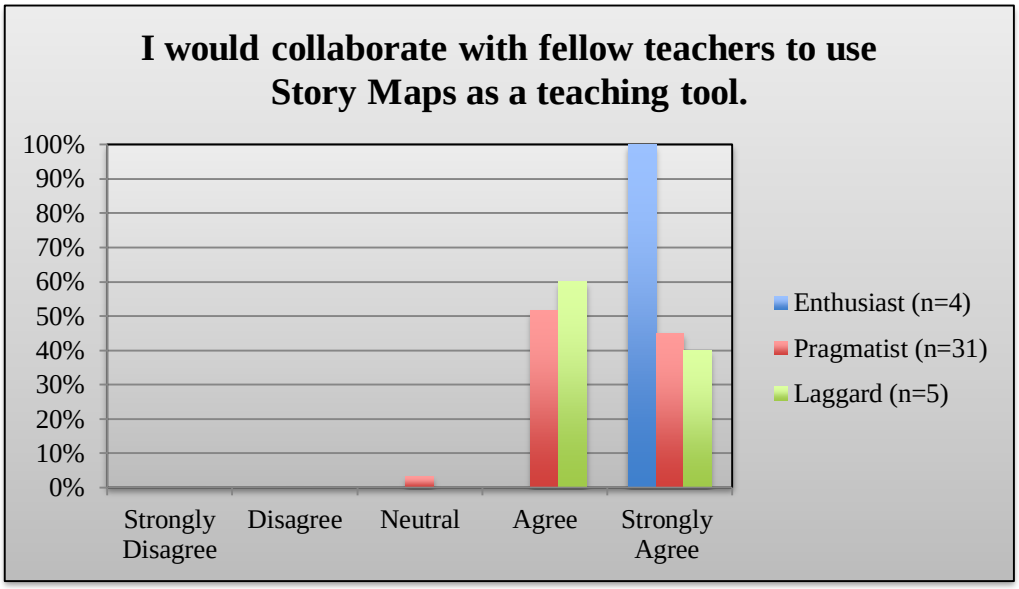

Figure 3.
Technology Profile survey responses to "I would collaborate with fellow teachers to use Story Maps as a teaching tool."

Creation and Use Challenges

In this section we report on research question two and its sub-questions:

(2) What are the challenges associated with creating and using a Story Map in a K-12 classroom?
   a. Which obstacles do teachers identify when developing Story Maps?
   b. Which obstacles do teachers identify as potential problems when using Story Maps in their classrooms?

c. Would teachers support Story Map development by students? If so, which grade level is appropriate?

2a: Development Obstacles?

The participants identified a few challenges concerning the creation and use of Story Maps in the classroom. Regarding the item "ArcGIS Online is intuitive and easy to navigate" (n=40), 65% of the participants chose Agree while 12% chose Neutral or Disagree. Similarly, 65% of the participants chose Agree and 10% chose Neutral in response to the item "It was easy to create a web map" (n=40). The responses to these two items are more neutral than most of the previous items, but this is not unusual considering that most participants had never before explored ArcGIS Online. Given that this was the initial exposure for most participants, the survey responses are still encouragingly positive. Few substantive differences in responses exist among the technology, age, or education subgroups.

The open-ended questions provided other useful feedback, but one teacher summed up the overall concerns well:

> *"Like with anything similar to this, time is needed to play around and learn. Not hard to do, just foreign. Also, sitting down, planning data, finding it, remembering how everything works takes time."*

Despite any hesitancies or obstacles identified by the participants (see Table 3), 97% of the participants chose Agree or Strongly Agree in response to the item "I enjoyed building a Story Map with the interactive builder" (n=39).

Table 3.
Likes and dislikes concerning the creation of Story Maps

Question	Identified Themes	% of Total Responses
Additional thoughts about what you did or did not like about *creating* Story Maps?	Generally positive	36%
	Difficult without technical experience	14%
	Liked step-by-step instructions	13%
	Interactive	13%
	Takes time to create	7%
	Generally hesitant	7%
	Simple	7%
	Like that Story Maps are web-based	3%

Overall, the participants responded favorably to the process of developing a Story map. Although this was the first exposure to ArcGIS Online, participants felt that the web-

based interface was fairly intuitive, interactive, and easy to navigate. Concerns emerged, however, citing a lack of time and technical knowledge as hindrances to creating a Story Map.

2b: Classroom Use Obstacles?

As identified in previous research, classroom technology (both availability and institutional support) continues to be problematic for using GIS in K-12 classrooms as is professional development/training (Table 4). For example:

> *"I do believe my students may find this difficult, [so I] need to keep it simple. My biggest obstacle though is the lack of technology at my school."*
>
> *"Computer access is limited at my school. Time constraints would also be a consideration."*
>
> *"Utilizing student captured images with certain internet filters can be problematic. Our district currently blocks Picasa, Facebook, and Flickr."*
>
> *"The only obstacle is a lack of technology in my school and technology knowledge of my students."*

Table 4.
Obstacles to creating or using Story Maps in the classroom

Question	Identified Themes	% of Total Responses
Additional thoughts about obstacles that would limit your ability to create or use Story Maps in your classroom?	Lack of technology at school	30%
	Need more training	24%
	Lack of time	19%
	School filters	16%
	Too difficult for students	8%
	Level of tech support at school	3%

The identification of obstacles is reinforced by participant responses to two related items concerning the use of pre-made Story maps and the development of custom Story Maps for use in the classroom. Eighty-eight percent of the participants chose Agree or Strongly Agree in response to the item "I would use *pre-made* Story Maps in my classroom" (n=40), while only 78% of the participants chose Agree or Strongly Agree in response to the item "I would *create my own* Story Maps for use in my classroom" (n=40). When analyzed by Technology Profile, it becomes clear that the Laggard and Pragmatist groups slightly favor using pre-made Story Maps as opposed to creating their own (Figure 4).

The Age Analysis revealed similar findings. The 51 and older age group exhibited a preference for using pre-made Story Maps over creating their own. One hundred percent

of the 51 and older age group chose Agree or Strongly Agree for using pre-made, while only 70% chose Agree or Strongly Agree for creating their own. Comparatively, minimal difference was found in the other two groups. When analyzed by Education Type, it appears that formal educators prefer using pre-made Story Maps, while informal educators prefer creating their own.

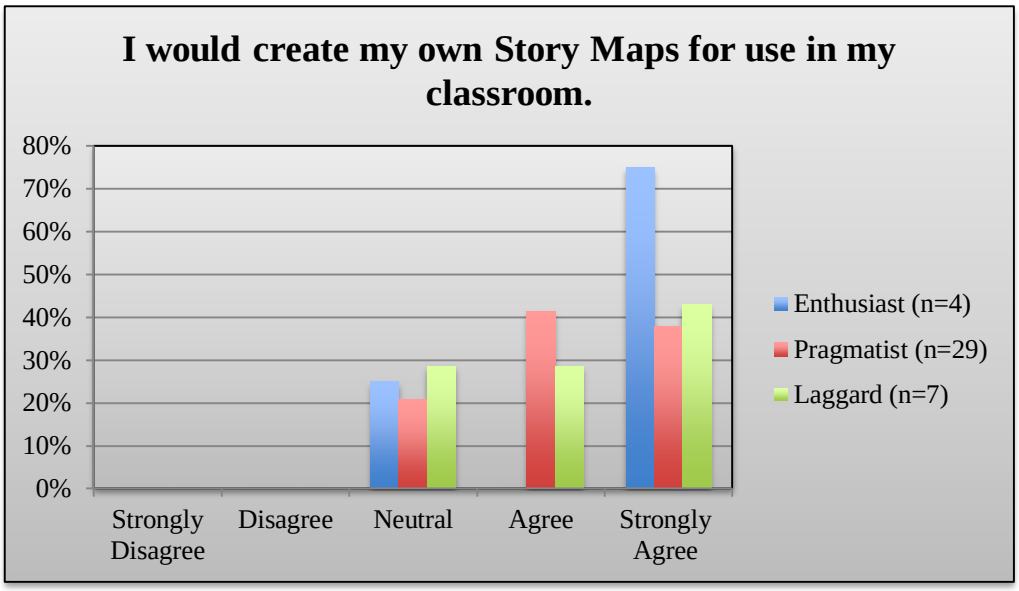

Figure 4.
Technology Profile survey responses to "I would create my own Story Maps for use in my classroom."

Most participants expressed a preference for using pre-made Story Maps as creating your own Story Maps takes time and technical knowledge. For almost all participants, the workshop was their first exposure to this new web application. However, 57% of the participants chose Agree or Strongly Agree in response to the item "I would be more likely to use Story Maps in the classroom if an additional professional development workshop was offered" (n=37). This was especially true for the Pragmatist and Laggard groups, for the 51 and older age group, and for formal educators.

Overall, the participants identified a number of obstacles that could serve as potential problems when using Story Maps in their classrooms. A lack of computer access at school, a need for additional training, and a lack of time constituted the most often cited challenges. Because of these potential hindrances, some groups of participants expressed a preference for using pre-made Story Maps as opposed to creating their own. Despite this initial preference and hesitancies concerning the identified obstacles, some groups of participants reported that they would be more likely to use Story Maps in their classrooms if an additional professional development workshop was offered.

2c: Student Story Map Development?

Although a number of obstacles could pose problems for classroom implementation, the participants responded positively to the idea of their *students* creating Story Maps. Seventy-nine percent of the participants selected Agree or Strongly Agree in response to the item "My students could create a Story Map using the interactive builder" (n=34). When analyzed by Education Type (Formal n=24; Informal n=10), 83% of the Formal group and 70% of the Informal group chose Agree or Strongly Agree. This demonstrates that informal educators, in addition to formal educators, see the potential for students to create Story Maps even though informal educators may not necessarily have a consistent classroom of students. In addition, 25% of the total responses to the open-ended question regarding participants' plans for using Story Maps in the classroom (n=55) indicated potential use for student-centered projects.

Overall Findings for Research Question Two

Analysis of the survey feedback and open-ended question responses revealed a number of challenges associated with creating and using a Story Map in a K-12 classroom. Despite fairly favorable responses concerning the ease, intuitiveness, and enjoyment of ArcGIS Online and the associated web maps, participants identified a number of obstacles when developing Story Maps, including a lack of technology at school, a need for training, and a lack of time. Although the Enthusiast and Informal groups preferred to create their own Story Maps, many participants, particularly those with greater concerns regarding the availability of technology, training, and time, expressed a preference for using pre-made Story Maps. However, many participants indicated that they would be more likely to use Story Maps in their classroom if an additional professional development workshop was offered. Furthermore, despite the obstacles, the majority of participants supported the idea of their students creating Story Maps.

Discussion

The goal of this research was to establish an understanding of teachers' perceptions of Esri Story Maps as effective teaching tools. The novelty of the product means that few other studies from the fields of GIS or educational technology have attempted to examine Story Maps and their potential as an innovative educational technology.

Major Findings

Perceived Ease of Use

Within his Technology Acceptance Model, Davis (1989) identified two key variables that influence an individual's intention to use a technology: perceived ease of use and perceived usefulness. Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (1989, 320). Similarly, Venkatesh et al. (2003) cite effort expectancy as one of four key constructs that directly determine user acceptance and behavior and define it as "the degree of ease associated with the use of the system" (2003, 450). In this study of teachers' perceptions of Esri Story Maps, an overwhelming majority of the participants felt that Story Maps were

user-friendly, interactive, and engaging. This is supported by the findings of Battersby and Remington (2013) in an informal study of student use of Story Maps at the university level. In addition, multiple pieces of feedback from the open-ended question concerning likes and dislikes about using Story Maps pertained to their interactive nature and ease of use. These findings are very encouraging as the complexity of GIS software was often cited as a major barrier to adoption and implementation by K-12 educators (Baker 2005; Meyer et al. 1999; Kerski 2003).

With respect to actually creating a Story Map using web maps and ArcGIS Online, participants expressed slightly more neutral sentiments. When asked about their likes and dislikes concerning the process of creating Story Maps, for example, one participant said, "We had really good step-by-step instruction, but I would have been daunted by prospect of creating on my own (2-1)." These findings are not discouraging, though, as the workshop was the first exposure to Story Maps for most participants. In terms of Rogers' Diffusion of Innovations Theory (2003), the participants were still in the first stage of adoption which is characterized by an initial exposure to the innovation that sparks an interest and encourages potential adopters to begin gathering information. This is demonstrated by participants reporting that they still enjoyed the process of building a Story Map with the interactive builder on ArcGIS Online. Nevertheless, these findings underscore the importance for explicit instructions and organized training. If participants had received no training or step-by-step instructions, it is likely that they would have expressed less positive perceptions of using Story Maps.

Participants also expressed that their students would enjoy using Story Maps. The Technology Profile Analysis, however, revealed that the Laggard group, in comparison with the Enthusiast and Pragmatists groups, was more likely to express neutral feelings regarding the potential for their students to enjoy using Story Maps. The Laggard group was composed of participants who scored relatively low on the technology profile statements concerning their comfort level teaching with technology, the level of technical support available at their school, and their level of experience with geospatial technologies. Mumtaz (2000) and Ball and Levy (2008) found that a lack of teaching experience with technology was one of many factors that negatively influenced teachers' use of technology. A low level of technical support, identified as a facilitating condition by Venkatesh et al. (2003) and as a structural constraint by Buchanan et al. (2013), can also impede technology adoption. Similarly, multiple GIS studies have found that a lack of training in geospatial technologies can inhibit the adoption and implementation of GIS by K-12 educators (Baker 2005; Kerski 2003). Given their comparatively low scores regarding teaching with technology and experience with geospatial technologies, it is possible that the Laggard group struggled more than the Enthusiasts and Pragmatists during the workshops. This struggle, in addition to a relatively low level of technical support, could negatively influence their perceptions of the technology and therefore make it more difficult to envision their students enjoying Story Maps.

The Age analysis revealed similar findings. The 51 and older age group were the least comfortable with learning this innovative educational technology. This finding is supported by multiple technology adoption studies which concluded that technology adoption and use decreases as age and teaching experience increases (Waugh 2004; Smerdon et al. 2000; Russell et al. 2007).

Overall, participants perceived Story Maps as relatively engaging, easy to use, and enjoyable for students, but expressed more neutral feelings toward navigating ArcGIS Online and using web maps. While perceived ease of use is a critical factor in determining educational technology adoption, the perceived usefulness of the technology is also a major influence (Buchanan, Sainter, and Saunders 2013; Davis 1989).

Perceived Usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989, 320). Additional educational technology studies have also referred to this concept as utility and performance expectancy (Badia, Meneses, and Sigalés 2013; Venkatesh et al. 2003). Davis et al. found that perceived usefulness was actually a stronger influence than perceived ease of use on users' intentions to accept a technology and stated that "Users may be willing to tolerate a difficult interface in order to access functionality that is very important, while no amount of ease of use will be able to compensate for a system that doesn't do a useful task" (1989, 1000). This is echoed by Badia et al., who concluded, "In their decision-making, teachers value first, the extent to which technology acts as a lever to improve their students' quality of learning, and to what extent its use fits in with the teaching methods and curricular skills they want to develop" (2013, 801).

In this work we discovered that participants perceived Story Maps to be useful in a variety of contexts. They were viewed, most importantly, as a tool to better present material that meets academic standards. In addition, participants were willing to collaborate with peers to develop interdisciplinary Story Maps that could be used as cross-curricular teaching tools. Short responses indicated that participants planned to use Story Maps as supplements to existing lectures or presentations, as part of student projects, and for web outreach. Participants clearly perceived Story Maps as easy to use and applicable to their educational environment. A number of obstacles, however, could hinder the successful integration of Story Maps in classrooms.

Obstacles

Several conditions can inhibit the implementation of an educational technology like Esri Story Maps. Barriers can be classified in two distinct categories: first- and second-order barriers (Ertmer 1999). First-order barriers are extrinsic to teachers and usually refer to missing or inadequate resource provision (e.g., time, support, training, equipment). These have also been called structural constraints or facilitating conditions (Buchanan, Sainter, and Saunders 2013; Venkatesh et al. 2003). Second-order barriers are intrinsic

to teachers and refer to teachers' attitudes, beliefs, knowledge, and skill regarding technology use. These could also include the concepts of self-efficacy, computer anxiety, and experience with the use of technology (Bandura 1977; Ball and Levy 2008). First-order barriers are easier to quantify and can often be remedied with better allocation of time and money, while second-order barriers are more difficult to measure and overcome as they are deeply-rooted personal beliefs. The type of barriers facing an educator may moderate the extent to which they are capable of implementing a new educational technology. Whether first- or second-order barriers, Audet and Paris noted, "Even when the benefits of an innovative practice are recognized, the motivation to change may dwindle if a teacher encounters major difficulties during implementation" (1997, 294).

Participants identified multiple factors, including a lack of technology, need for training, lack of time, and school filters, which could serve as obstacles to the successful implementation of Story Maps in classrooms. However, multiple groups expressed a higher likelihood of using Story Maps pending an additional professional development workshop. Although encouraging, these results point to a number of factors that must be addressed in order to lay the foundation for the adoption of Story Maps as teaching tools.

Conclusion

This study aimed to establish an understanding of teachers' perceptions of Esri Story Maps as effective teaching tools. Story Maps combine digitized, dynamic maps with other story elements to help the creator effectively convey a message. They couple the benefits of a GIS with an easy-to-use, non-technical interface that can be accessible to both teachers and students.

Before collecting data, a sample Story Map illustrating the Congaree National Park Boardwalk Tour was created and aligned to state academic standards and literacy skills. This Story Map served as an example of a final, polished product that participants could examine at the beginning of the workshop. A detailed tutorial was also created outlining the specific steps to create a Story Map. Step-by-step instructions and corresponding screenshots helped the participants to follow along during the workshop and also provided them with the documentation necessary to practice in the future. A survey unique to this study was designed to assess participants' perceptions with a variety of Likert-like statements and open-ended questions.

Forty-two educators participated in the study, ranging from pre-service to in-service K-12 educators as well as informal educators working for local government organizations and conservation groups. Analysis of the survey data revealed that participants perceived Story Maps to be user-friendly, interactive, and engaging. Furthermore, participants communicated that their students would enjoy using and have the ability to create their own Story Maps. After just this initial exposure to the technology, participants expressed more neutral sentiments concerning the ease with which they created web maps and navigated ArcGIS Online. Consequently, some

expressed a preference for using pre-made Story Maps over creating their own Story Maps. Participants also felt that Story Maps could be used to present materials that meet academic standards. Additionally, they conveyed enthusiasm for collaborating with fellow teachers to create interdisciplinary Story Maps to be used at teaching tools.

Despite the ease of use and utility of Story Maps, participants noted several obstacles to classroom implementation, including a lack of technology at their schools, a need for additional training, a lack of time, and internet filters that could restrict access to pertinent websites. Although some obstacles are extrinsic to teachers and difficult to address without substantial investments of time and money, certain steps should be taken by involved stakeholders to encourage the use of Story Maps in educational settings and positively affect the current state of geographic literacy. As teachers' use of educational technologies is often related to the technologies they use in their pre-service programs, increased emphasis should be placed on using GIS and Story Maps as both teaching and learning tools within teacher preparation programs. Furthermore, professional development events should be provided for in-service educators to provide them with the knowledge and skills necessary to effectively use and create Story Maps. These events, in addition to teaching technology skills, should focus on the pedagogical applications of Story Maps and their ability to support standards-based education. Given the results of the current study, initial professional development efforts should focus on developing younger, more technologically-savvy educators who could then serve as leaders and mentors to their less experienced colleagues. Professional GIS users from the local community could function as sustained technical support providers and use their extensive GIS knowledge to mentor classes, schools, and clubs.

We also recommend that involved parties, such as Esri or GIS education consultants, pay particular attention to the varying needs of educators. For example, this study revealed that formal educators desire pre-made Story Maps that are aligned to academic standards and ready for immediate use in the classroom. Educators wishing to create Story Maps for or with their students will require simplified documentation with explicit directions designed for educational settings. Informal educators, on the other hand, have little need for pre-made Story Maps and therefore require sufficient documentation on creating their own Story Maps. They would also benefit from seeing a variety of successful Story Maps created by informal educational institutions which could serve as examples for their own projects.

Given their newness, limited research has studied Esri Story Maps or their applicability to classrooms. Although this study establishes a basic understanding of teachers' perceptions of Story Maps as effective teaching tools, further research is necessary to explore how teachers may or may not apply Story Maps to their classrooms, the obstacles they face, and the resources they need.

Methodological limitations of this study present opportunities for future research to examine teachers' perceptions of Story Maps at a larger scale. A larger and more representative sample population may unveil that perceptions are further moderated by age, experience, gender, and school circumstances. For example, it would be useful to

explore how teachers' perceptions may or may not differ based on their experience with educational technologies in pre-service programs or their level of professional development attendance during in-service years. Furthermore, new obstacles may be uncovered by research that considers both teachers in well-equipped, technologically advanced schools and teachers in poorly provisioned schools.

Future research should also study how students' test scores, behavior, spatial thinking skills, and geographic knowledge are affected by the use of Story Maps as an educational technology. Teachers will invest their time and energy in learning a new educational technology if it is proven to be superior instructional method that increases student learning outcomes (Guskey 1986). If it were shown that students' learning outcomes and level of engagement were improved by using or creating Story Maps, teachers may be much more likely to adopt the technology in their own classrooms.

Furthermore, additional studies should be conducted to assess the benefits and challenges associated with using a web-based GIS like ArcGIS Online. Esri's recent donation of ArcGIS Online organizational accounts to every classroom may forever alter the role of GIS in education (Esri 2014). Although web-based GIS platforms like ArcGIS Online may lessen certain instructional and IT concerns, Battersby and Remington (2013) discovered that the administration of an organizational account and the current credit expenditure system posed challenges to the efficient use of Story Maps in educational settings. Moreover, the ArcGIS Online interface can change slightly with new releases and updated functionality, as is common with online software. The current study focused only on teachers' perceptions of the web application, so future research should explore teachers' perceived challenges of working within ArcGIS Online and managing the recently donated organizational accounts, as well as how a changing interface affects teachers' level of comfort with using the product. Additionally, Story Maps compose just a small amount of the functionality available within ArcGIS Online, so future research should examine how teachers and students perceive and use the more extensive analytical functions of ArcGIS Online.

In sum, Story Maps have the potential to play a large role in encouraging spatial thinking skills and geographic knowledge in K-12 and informal classrooms. Although several obstacles may impede their implementation, the overwhelmingly positive perceptions expressed by educators imply a budding future for Story Maps as a successful and effective educational technology.

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Appendix: Story Map Perception Survey

**Note: the survey format has been altered slightly from the original to match the journal formatting guidelines.

The purpose of this research is to record teachers' perceptions of Esri Story Maps. You are asked to complete this survey as a teacher participating in a Story Maps workshop. The results of this research will be used to direct future Story Maps development for use in K-12 education. This survey will take approximately 10 minutes. Survey participation is voluntary and responses will remain anonymous.

I. ABOUT YOU

Age _____ # Years Teaching _____ Current Grade Level Teaching _____

Current Subject(s) Teaching _____ _____ _____

Circle the choice that best describes you:

My comfort level teaching with technology (PowerPoint, Mobile devices, Tablets)	Low	Medium	High
The level of technical support available at my school (IT support, internet access)	Low	Medium	High
My level of experience with geospatial technologies (GIS, GPS, Google Earth)	Low	Medium	High

II. USING STORY MAPS

These questions relate to *using* Story Maps. *Circle* the choice that best describes your belief:

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Story Maps are user-friendly.	1	2	3	4	5
Story Maps are interactive and engaging.	1	2	3	4	5
My students would enjoy using Story Maps.	1	2	3	4	5
Story Maps can help me better present material that meets academic standards.	1	2	3	4	5
Story Maps could be used to be present material from a variety of subjects (i.e., interdisciplinary).	1	2	3	4	5
I would collaborate with fellow teachers to use Story Maps as a teaching tool.	1	2	3	4	5

Additional thoughts about what you did or did not like about *using* Story Maps?

How would you plan to use Story Maps in *your* classroom? (i.e.: specific topic, subject, lesson, student projects)

III. CREATING STORY MAPS

These questions relate to *creating* Story Maps. *Circle* the choice that best describes your belief:

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
ArcGIS Online is intuitive and easy to navigate.	1	2	3	4	5
It was easy to create a web map.	1	2	3	4	5
I enjoyed building a Story Map with the interactive builder.	1	2	3	4	5
I would use *pre-made* Story Maps in my classroom.	1	2	3	4	5
I would *create my own* Story Maps for use in my classroom.	1	2	3	4	5
My students could create a Story Map using the interactive builder.	1	2	3	4	5
I would be more likely to use Story Maps in the classroom if an additional professional development workshop was offered.	1	2	3	4	5

Additional thoughts about what you did or did not like about *creating* Story Maps?

Additional thoughts about obstacles that would limit your ability to create or use Story Maps in your classroom?