Restructuring Activity and Place: Augmented Reality Games on Handhelds

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Abstract: Human activities are constrained by interconnected and overlapping factors of: biological abilities, time, space, and social narratives. I focus on how the interplay between two of these factors, space and narratives, can be mediated with cultural tools of locative technologies such as Augmented Reality games and GPS units. In order to understand how *place-based pedagogies affect learning* and *how locative technologies, like Global Positioning Systems (GPS) and Augmented Reality Games on Handhelds (ARGHs), help connect learners to cultures of place* I examine experiences with place-based video games in a deep woods camping environment. Drawing together research in sociocultural learning, design, embodiment, environmental education, experiential education, human geography, and video games, this paper demonstrates how ARGHs can restructure a learning activity to (1) better connect learners to place, (2) increase and mediate their physical activity and social interactions, and (3) help enculturate them into a community of practice.

Situating Vignette

Towards the end of each summer, while the older boys were doing manly things on the [distant mountains], we others took part in the wild pursuit of thieves, kidnappers, and other nefarious individuals.

That first summer of mine, quite unexpectedly, as we were about to set out on our regularly scheduled trips one Tuesday morning, we were all called together and the cold facts were put before us. Something terrible had happened; I am sure that I don't remember what. Plans had to be changed at the last moment, and all our energies were to be devoted to helping the local authorities, whoever they were, hunt down the criminals and bring them to justice. At the same time we would uphold the honor of the camp, and in all probability bring fame and fortune to ourselves and our counselors.

Assignments were quickly made. For the sake of expediency, the original trip groupings would be maintained, but we would travel unexpected paths. All of this had been well arranged beforehand; and I can visualize the counselors now constructing the complicated plot in the evenings after we had gone to bed. Now they were ready to play it out.

I can't remember much of that first Mystery Trip except that it rained. It rained all the time. The villains, whoever they were, had left clues and trails as they challenged us to track them down. Coded messages were found and deciphered. The net was slowly tightening. In tracking those undesirables, we learned more than we at the moment wanted to know about following trails in the woods. I clearly remember looking for stone cairns on the mountain side under what were certainly not the most favorable conditions. (Price, 1986)

Background

We live in *place* (culturally-enriched space). Technological advances have flattened the world, and widened our scope of understanding far beyond our immediate surroundings (Friedman, 2005), but we must not lose sight of the particulars that makes our own places unique.

We are socially-minded and spatially-embodied navigators, learning from others and from our own experience designing solutions to problems we encounter in physical and social environments. As a result of this "inescapable embeddedness of human beings in natural systems," all learning is ecological (Smith & Williams, 1999). While incentives to learn are largely sociocultural (Vygotsky, 1978), our best learning is experiential -- based largely on individual and social experiences as embodied beings (Dewey, 1910). In sharing our own stories and experiences, we iteratively redesign and reinterpret larger cultural stories in order to better fit our situational knowledge (Bruner, 1996). The transmission of community-derived situational knowledge to individuals is done through cultural models and stories of identity, often tied to shared understandings in the geographical spaces of experience, thus changing them from spaces into culturally-relevant places (Coles, 1989; Gee, 1999; Holland & Quinn, 1987; Tuan, 1977).

We can situate learning in place better than we are currently doing. Place-based technologies like *GPS*, *Google Earth*, *Google Maps*, and *Google Local* are feeding the need to better understand our relations to space and place, and are ushering in a world of place-based technologies that further situate us in our places in the world in a manner that respects and presents the places of others. Whether integrated into school structure (Squire et al, 2007), or in informal learning environments as this paper discusses, ARGHs can offer a rich model

for deep interaction in and with the places we live. To situate learning better, I use an idea that I call Place-based Inquiry (PBI), which contends that *place shapes identity and learning -- and identity and learning shape place*. We live, and learn to live, in a culturally relevant, physical world through stories and rules, and we redesign and interpret stories and rules (and physical world) to better fit our needs and perspectives. We are shaped by stories that make the *spaces* in which we work and play into culturally rich *places*, and we modify those stories to exert our own interpretation of the significance of those places into our identities and the identities of our children.

Drawing together research in sociocultural learning, design, embodiment, environmental education, experiential education, human geography, and video games, this paper demonstrates how ARGHs can restructure a learning activity to (1) better connect learners to place, (2) increase and mediate their physical activity and social interactions, and (3) help enculturate them into a community of practice.

Theoretical Framework

We need to invest in place-placed pedagogies to reconnect learners to the places and communities they live in (Gruenewald, 2003), because although we live in and move through it every day, we take place for granted (Casey, 1997; Geertz, 1996). As a result, there is little research on its effect in contemporary learning (Ellsworth, 2005; Orr, 1992). The classrooms that Dewey (1900) termed as "made for listening" (p. 31) are largely still in contemporary schools (Meyer, 1992).

Like place itself, the *importance* of place manifests itself not as a central focus of activity-centered theories but hides in plain sight all around studied activities. For example, in his seminal study of the navigation of a ship, Hutchins (1995) socially situates cognition in a system of distributed beings and tools. Activity Theorists rightly focus on social distribution of knowledge and socially designed tools, but it is important to note that the system he examined was for navigating a ship through geographical space, and the physical attributes of the places that the participants on the ship operated within had much to do with the *affordances* (Norman, 1993) of those places. Additionally, in Pea's (1993) focuses on tools and modes of representation, too often we overlook that the affordances and constraints physical setting, whether designed or merely repurposed, also serves as a tool or mode of representation.

Exploring pedagogically charged environments outside the classroom, Ellsworth (2005) argues that architects, designers and museum curators create "processural paths" through mediated environments -- and therefore new pedagogies of sensation, not "as having bodies" but "*as bodies* whose movements and sensations are crucial to our understandings" (p. 27). Video game designers are doing this with less physicality, creating "immersive worlds with embedded rules and relationships among objects that enable dynamic experiences" (Jenkins & Squire, 2002: 65). However, rather than address physical learning environments, much of recent technology research in education focuses on shared activity in *virtual* places of cyberspace, promising anytime, anywhere learning. And while amazing learning happens in online sociocultural learning tools like video games, chat, wikis, and blogs, the focus may also increase a larger disconnect from the land and physical places students actually live in and rely upon.

This study investigates how the use of locative technologies, specifically Augmented Reality Games on Handhelds (ARGHs), can bolster a connection to lived environments -- a sense of place -- through an immersive deep woods hiking game. These games merge handheld computers with Global Positioning System (GPS) units. For players, game space is real space, tracked by GPS and plotted onto a handheld computer (Klopfer & Squire in press). The space that they move through is familiar -- with recognizable and culturally familiar features -- but games reveal added or *augmented* content that is meaningful within its frame. In the activity of *playing* an AR game, players move their own bodies (instead of digital avatars) through culturally significant real-world environments collecting data to solve problems and attain goals. University of Wisconsin, and MIT researchers have demonstrated effective learning in ARGH experiences (Squire & Jan, 2007; Klopfer & Squire, 2003).

To explore learning and engagement through AR technology at a deep woods camp in Maine, I resurrected and updated a camping activity that had not been practiced for over 40 years. I modified the *Mystery Trip* to evolve through a succession of design narratives (Hoadley, 2002) to allow for iterative updates that included players' own cultural infusions into it. The *Mystery Trip* began in the early 1920s when campers were "conscripted" to help local authorities track criminals, as illustrated in the vignette that begins this paper. It was the "not most favorable conditions" referred to in this paper's opening vignette that led to the *Mystery Trip*'s demise, as rain destroyed some clues, and others were never found, leading to narrative dead-ends. Additionally, it required too much time and energy to create and plant clues for campers to find. AR technology made possible a *Mystery Trip* adventure with location-based codes, pictures and video clues that cannot be accomplished with a map-and-compass game. The GPS-enabled game allows working games to be created and deployed quickly without having to plant clues. The design experience allows participants to test a game and offer feedback and suggestions, simultaneously taking on roles of player and designer, and working collaboratively on tasks related to camping, playing, and critiquing/redesigning the game.

To design such a game requires understanding the lore of the place -- jokes, clues, and insider knowledge that older campers understand and younger campers are on the verge of comprehending -- the zone

of proximal development in learning the Discourse of a community of practice (Vygotsky, 1978; Gee, 1992; Lave & Wenger, 1991). It requires knowledge of physical and cultural geography of landscape, an awareness of places that current campers' older relatives may have stories about, and a loose narrative in the stylistic vein of the dry wit associated with the camp since its inception. In short, design demands a deep situated experience of camp culture. With this as a goal, ARGH was introduced to the camp directors, and they agreed to try it.

Methods

Methods include observations, videotaped interviews, written journals, and software iterations of the game as it developed. A form of Discourse analysis (Gee, 1992) was employed to ascertain participants' engagement, involvement, and understanding of their social/working communities. Participants over three summers were comprised of twenty 11-15 year-old boys and five 19-30 year-old men, as five distinct groups ranging from three to six members, including a counselor. Most were middle- to upper-middle class Caucasians, although a few attended at steep discount through a camp scholarship fund.

In 2005, I approached a group of five experienced campers, handed them a GPS unit and notebook, and gave them the task of creating a game. They spent a four-day hiking trip mapping out potential game space, creating potential characters, and building a loose game narrative for the ARGH, but because they had not played an AR game, they did not fully understand what was possible or even what to do. Their notes were used to create *Wild Moose* (Martin, 2005). The following summer campers played and redesigned the game with GPS devices and handheld computers, including: a Bluetooth-enabled Pocket PC handheld computer (PDA), a Bluetooth GPS unit, and, due to concern with sending delicate and expensive electronics into the woods with 10-16 year-olds, a waterproof, shock-proof, dust-proof, child-proof, floating, protective case (see Figure 1). In 2007, the iPaq and GPS receiver were replaced by a Pharos Traveler handheld computer (with integrated GPS support). A standard GPS was also sent on all trips for mapping out interesting locations and routes for future games, and to avoid getting lost if the PDA/GPS system stopped working, which happened regularly.

Figure 1. Playing an augmented reality game in the woods with hardware used in 2005-2007.

Procedures evolved with each implementation in a series of design experiments (Brown, 1992). After obtaining Human Subjects release from parents and campers, participants were given a short tutorial on the hardware and game. They were told that they are "beta-testers" of a new and experimental game, and were asked to critique it and keep a group journal of suggestions for improvement. They then packed and embarked. Because the game takes place throughout an already-established 4-day trip, and campers already have experience with 4-day trips, the ARGH builds on prior camping and hiking skills. They followed a GPS-triggered game narrative that unfolded as they hiked to locations in a 16 square mile area (see Figure 2.) mapped onto the PDA. The game employed a simple linear narrative because of high potential for wilderness and technology complications, and a camp culture that dictates that experience focus on hiking and camping.

The first 2006 group started their trip following the *Wild Moose* game narrative, and had a full day of experience with the AR game in heavy rain before the Bluetooth GPS unit shorted out in the unprotected pocket of a soggy eleven year old. The remainder of the four-day game had to be played in manual mode (without GPS triggering of events). Fortunately, the trip was lead by an enthusiastic Australian counselor, and with his lead, and a good understanding of the constraints and affordances of the game, the campers wrote a completely new game narrative called *Mitchville: Where the War Began*, based loosely on the ideas behind the 1984 movie *Red Dawn*, and John Marsden's (1995) *Tomorrow, When The War Began*. By the time the replacement GPS arrived, I had ported the new narrative into a game, and successfully tested the initial entry trigger of the game.

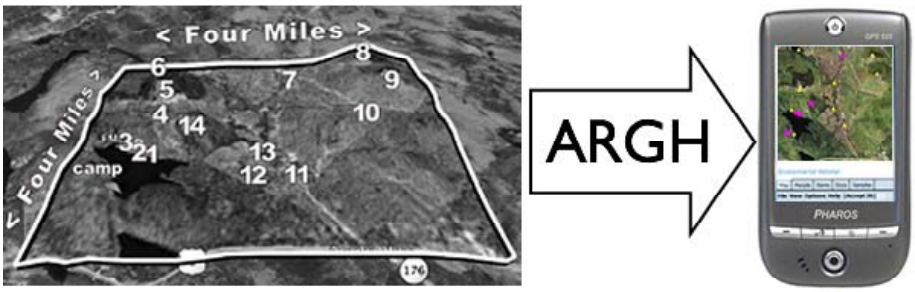

Figure 2. The ARGH took place in a 16 square mile area of mountains and woods mapped onto a GPS-enabled PDA. Players hiked to subsequently numbered locations that triggered bits of the game narrative.

The starting point in their redesigned game was familiar to participants -- the base of a trail all campers had all hiked. The game narrative unfolded message by message throughout the trip. At the first trigger spot, the handheld computer revealed itself as a Star Trek style communicator and displayed an urgent "live message" from the assistant director of the camp (this paper's first author) announcing that camp had been taken over, and instructing them to get to the top of the mountain and await further contact. In order to get around the fact that the handheld computer is *not*, in fact, a communication device, the narrative cleverly framed that the assistant director's communicator was reportedly damaged in the melee, so one-way communication is the only option. As the trip progresses, they got more clues that helped them reconstruct the "real-time" story of what happened at camp -- and better understood how they could help.

When participants returned to camp after four days, they were individually interviewed, using a script of 13-26 questions, with appropriate follow up questions. Interviews were captured on video, usually isolated from others -- although at a small base camp that was not always possible or practical. Interviews ranged from 17 minutes to an hour in length, and were analyzed for emergent themes.

Results

Although the user-design components of this study did not work as hoped (see Martin, et al, 2008), interviews revealed the ARGH experience increased understanding of, appreciation for, and connection to, the land where it takes place. "Getting back to nature" -- a big draw of deep woods camps -- is obvious, but much also depends on group relationships. On a four-day trip, campers spend roughly 80 straight hours together repeating a sequence of hiking, resting, setting up a campsite, cooking, eating, cleaning, etc. Challenged by both terrain and weather, and lacking layers of modern climate control between body and environment, natural elements take on significant and deeply embodied meanings. Campers are challenged by environment, group dynamics, their own bodies, and the ARGH activity -- and the ARGH's restructuring mediates it all.

The results indicate that the augmented reality game activity reframed the campers' hiking experience in a way that seems much closer to the type of 1927 *Mystery Trip* experience that Harrie Price described in the introduction of this paper. Over the years, kids had become used to trips, valuable in their own way, where they simply geared up and followed the directions of their counselors. They hiked on trails from point to point, paying more attention to the points than to the land between the points. The reasons for hiking at all on regular trips was often "because the counselor said so" and the route was typically pre-planned, so there were few surprises. The augmented reality activities gave trips an *unfolding narrative* that *motivated off-trail movement* while the GPS-tracking *reassured* campers of their safety. This in turn *restructured* participants' perspective of *place*, as well as restructuring an understanding of *self* -- as individuals and as they related to camp culture.

Mediating Connection to Place

The locative technologies of ARGH scaffolded a more intimate connection to place by motivating off-trail movement and making it easier. The significance of this emerged in almost every interview. Because ARGH technology relies on triggering specific GPS *locations* rather than the *routes* between locations, the narrative also focused more on those places and less on trails between them. It specifically encouraged off-trail movement in order to avoid scouts that the enemies may have sent out. Campers were left to determine the paths much as one might draw lines in a Connect-the-Dots game -- while direct lines are implied, players can choose to connect dots however they see fit, but the landscape between locations rarely allowed for straight lines. The unfolding narrative acted as motivator for campers and counselors alike.

> Camper 3: On a regular trip you just want to get to the next campsite, but on this you have to get to this mountain to stop the radio signals then you have to go to this one and that one. ... so you could finish the game and see what happens next.
> Counselor 1: it's not just "Oh let's just climb this mountain because, it's what we're doing" it's "let's hike this mountain because that's the next part of the game.... had that not been a part of

it we almost certainly would have just gone up the regular trail.
Camper 7: You think that you don't want to go on the trails because the other camp would be there waiting for you....

Likewise in the ARGH, established trails offer *an* option, but not the only option, and often not the *best* option, for moving between trigger points. By taking advantage of opportunities to go off-trail, players get a rawer, less-manicured perspective of the land; one individualized by how they moved through the land. Moving beyond the trail is a qualitatively different, and almost always more difficult experience than what they experience on most organized hiking trips in managed parks and lands where hiking is essentially confined to trails. Some groups chose to do minimal off-trail "bushwhacking" and others chose to do a lot, depending on the weather and how they felt at the time. In all groups, seeing their exact GPS-tracked position on the handheld computer screen reassured them that they are not lost, letting them focus more deeply on enjoying other aspects of the experience.

Counselor 1: It was a reassuring addition to having the map and compass. And also allows you to be a bit more adventurous. Like, we can bushwhack down here, and just follow our GPS back ... if we get lost, the line's right there.
Camper 6: that's always been a worry of mine when bushwhacking. That you *will* get lost ... whereas with the GPS you know how far you're off from the road and where other places are.

Trails represent established or "conquered" land; the decision of where to go is already decided by those who made the trail. They are almost "paved" for hiking. Whereas hiking off-trail suggests an exploration of uncharted lands. In actuality, these lands are well mapped and crisscrossed with old logging roads, and hunting and snowmobile trails. However, because these paths are not on the official topographical maps, participants see themselves as pioneering discoverers, mapping for the first time an "official version" of the area for future campers.

Camper 9: We were thinking about assisting other people, marking waypoints, finding out how far, how fast.

Mediating Collaboration through Place

Members of each group said the ARGH forced a greater sense of social interaction themed around the land than other trips did. Because the handheld's small screen limits how much information is displayed, along with the game narrative's encouragement of off-trail hiking, meant participants continued to rely on maps -- even more than on trips without the GPS, because much of the land they hiked through had been clear-cut within the past ten years, traditional trails the camp had used for decades had been demolished and campers had to help each other make their way through thick regrowth. Additionally, instead of walking a trail's "tunnel" they had to collaborate on navigation, point out hazards and easier routes, and in general help each other make it through the thick growth. Rather than the GPS replacing use of map and compass, the ARGH actually directed more debate and discussion between the participants around the use of, and references to the map.

Camper 3: There was more teamwork, when we had discussions about directions and you'd think we had to go one way, and they said, "no, the other way," and show you on the map.
Camper 7: It was more challenging; like you get to areas where it's hard to get through so you have to push the trees aside and help everyone get through. I thought it was a lot more challenging and fun helping other people get through, because you get into one area and you realize "oh, this is not the areas we're supposed to be going to!"

This indicates participants paid significant attention to landmarks, swamps, streams, and peaks to map them onto topographical maps in order to find optimal paths between trigger points. They then debated and decided which way to take, adjusting with new information they triggered along the way.

Mediating Activity in Place

The ARGH experience significantly altered the structure of the trip for participants by shifting the framing of the often-difficult task of hiking, bushwhacking, and climbing mountains, from "work" to "play." As part of a game, the campers were more motivated to complete tasks.

Camper 3: On a regular trip you just want to get to the next campsite, but on this you have to get to this mountain to stop the radio signals then you have to go to this one and that one ... so you could finish the game and see what happens next.

Contributing to the culture of their camp community through the design of the game as cultural artifact appealed to some participants, while others were content with simply playing the game. The pilot group in 2005 spent considerable time getting their minds around the idea of ARGH, and the first group in 2006 saw as their primary mission recreating the game. Both spent considerable time and effort seeing land as game designers.

> Camper 9: We're so used to technology now that it can be used for things -- old things -- that have always been there, like this land, and nature. They can mix together and make fun things like this, and the GPS, and can be used to map out the area and really help kids enjoy the outdoors. It's just a new way of thinking ... using your imagination that the camp's been taken over and you have to get away from the evil [invading camp]. It kept me going.

Repurposing objects and landmarks for the game is required to make the game more "real." In the game narrative of the 2006 redesign, deer hunting platforms (hunters' towers) became sniper towers for the invading camp -- landmarks that players needed to locate but stay clear of, and even blueberry patches were considered.

> Camper 10: I was always thinking about how we could turn the land, like using it in the game. Like when we saw the saw the hunters' towers I knew we could use those in the game. And the blueberry patches -- several times I picked like 40 blueberries, put them all in my hand and shoved them into my mouth.

Mediating Connection to Body

The ARGH promoted greater focus on participants' bodies. Although berry patches did not make it into the game narrative because blueberries are deliciously relevant only in late summer, the discovery of blueberry and raspberry patches turned into mini-games on multiple trips, with their own rewards that cultivated tasty memories. The patches scratched the legs of some, and had them bragging about their find, and recounting how they survived the trip. A camp alumni who was a camper and counselor in the 1970s says embellished "fish stories" of survival are a large part of the camp culture -- the most innocuous hike can be framed as a life or death adventure that campers not only physically endured, but were tough enough to triumph over (Childs, 2002).

> Camper 8: I got to know how deep the woods were and how some logging and stuff really hurt the value of the land, walking through it. For instance, when an area of land that we had to bushwhack through was clear-cut, it was full of tall grasses and sticks and stuff buried in it that you couldn't see and you couldn't see your feet or where you're walking.
> Camper 1: And jumping from rock to rock at times, in fact there was one really deep hole with ground at the bottom that didn't look too sturdy. I'm like "Whoa! Don't fall down that" Of course J was really tired and was following me, and I didn't want him to fall in it.

Mediating Connection to Culture

The ARGH awoke an appreciation for looking deeper into, and staying connected to, local place. When the camp was founded in 1921, its campers explored the "wild" country directly around it. As the area developed and roads opened up "wilder" areas to be explored, they started to truck campers to these newly accessible places. Part of the reason this research was approved by camp owners was because a reinvestigation of local place to make financial sense due to rising gas costs. While the concept of vacation is often tied to "exotic" and visions of far-off places, the ARGH experience opened some to the idea that the local area is as filled with significant things as trips farther away.

> Counselor 2: To get to [popular regional trails] you have to drive for a long time and it gives you a disconnect between the place where you have as your home base camp, which most people have an emotional connection to ... And to be able to take a trip where you're really exploring the woods right around the camp and finding that you can be in a very isolated spot and still find all kinds of neat things, and even in some ways even neater things because it's things other people haven't necessarily discovered before.
> Counselor 1: There's a lot right here at [local lake], right around camp, and I never thought of that before. There's a lot to do out here, and it's a really cool area. I underestimated [this area].

For many, exploration of the land around camp was important because it connected them to an experience that their brothers, father or grandfather (and in one case, great-grandfather) might have had hiking the same mountains at the same age, further cementing their identity as a member of the camp community. A number of participants expressed appreciation for the game-prompted direction to climb the local mountain that the camp was named after. Other places in the ARGH do not actually exist, except as part of the camp culture.

One such place is Mitchville -- a mythical "town" that allegedly has a bowling alley, a soda fountain, and other amenities that the campers miss. It's actually an extremely primitive campsite in the middle of the woods.

> Camper 9: I never bushwhacked before. Last trip was more relaxed because we didn't have the GPS or game, and we didn't find Mitchville. We didn't move as much then. ... Going to [camp namesake] mountain was fun because I'm a "[camp name] -er!"
> Camper 3: We have courage. We take things. Like I kept saying to myself: "Power through!" when we were going through big thorny bushes, to just power through it. "Keep going!" ... Other camps might take pity -- a bit more pity. Instead of saying we gotta get there and just suck it up, they might stop and I don't know ... I think it's fun.

Discussion

The Restructuring Affordance of ARGH

The ARGH restructured participants' framing of their experience, resulting in changed behavior *and attitudes* toward hiking, and for some, toward an understanding of place in general, which might be temporary, bookended by the start and end dates of camp, and relegated to the sixteen square mile area of the ARGH, but some responses suggest an attitude change that may be more permanent. AR technology allows us to create pedagogically-charged real places (Ellsworth, 2005) inexpensively, and in many ways it allowed for more ridiculously imaginative and appealing scenarios. Whether based on real or fictional stories, this restructuring leads to real, physically-embodied experiences in places that then become important. By connecting the learning of new content to meaningful practice in physical place, we can tap into deeply embodied pedagogies of sensation in our experiences -- not *with* bodies, but *as* sensing and moving bodies with cultural understandings that mediate most of our conscious experiences.

Kids will play. In many ways restructuring the experience as a game does not change this. What changes is the perspective of the difficult tasks (hiking when tired, collecting wood for fires, etc.) from work-based to a play-based experience, where difficulties are merely game challenges to be solved or overcome. The physical expenditures they do may be the same (although in each of these ARGH experiences the bushwhacking significantly increased the physical expenditures compared to the non-ARGH version of the trip that was done in the past), but the *attitude* in doing it is qualitatively different. As with a good video game, players look forward to solving problems often primarily in order to be given another, more challenging one (Gee, 2003).

Connecting to Culture

Whether designing, critiquing, redesigning, or simply mapping, participants often felt good that they were participating in important work that would benefit the camp community. Rather than simply consuming a trip, they were actively participating in the creation of a new cultural tool that they saw as having a lasting impact on the camp community (Bruner, 1996). The transmission of this community-derived situational knowledge through cultural models and stories of identity are tied to shared understandings in the geographical spaces of experience. Sharing in this experience with a larger community through the ARGH and through stories about older *Mystery Trips* transformed the area into a specific culturally-relevant *place* that they had now directly experienced. They are more deeply connected to a larger community than just other members of the ARGH trip -- and this connection is important.

Importance to Education

We know that people often enjoy, and get deeply involved in, playing games for fun and competition, and in solving puzzles for the joy and feelings of competency in solving them. They like a good story and will bear discomfort in order to hear the end. We know too that people are generally social creatures and want to belong in a community. When they feel this they will work to build, promote, and defend the community. We know that many stories and communities are traditionally rooted in geographical places. We know all these things happen naturally and somewhat haphazardly in human cultures, and through the sum of them we are motivated to learn to become members of our respective communities.

Playing and designing ARGHs provides a possible framework to tie all these things -- stories, puzzles, games, community, and place -- together in such a way to more formally scaffold the natural process of learning. In offering people the opportunity to play together, and design games that highlight the cultural significance of their identities and place, they may be more motivated to care for each other as fellow community members, and to care more for their local environment as it takes on more significance to their communities, and thus, for them. This is a door to greater environmental stewardship that starts locally and grows globally. The formula for this to work is in place. The palm-sized platform is becoming more affordable and ubiquitous, as seen in the worldwide popularity of mobile phones, including in developing nations. Modern phones have the necessary components -- location awareness and computing power -- to run AR games.

The software promises to soon be accessible to mainstream users of technology such that every student might have constant access to handheld locative technologies that help further connect them to their local

environments. They could learn both by solving puzzles and following AR game narratives created by community peers, and through the complex and rewarding process of designing AR games for their peer groups.

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