Maps That Come Alive: Numeracy Engagement Across Multimodal Texts

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The digital age requires students to use a range of literacies in order to engage in and interpret an increasing array of multimodal communications. This case investigation describes the ways in which two students use and interpret maps when engaged in gameplay with popular culture multimodal texts. The study encouraged the participants to share their experiences as they played their game. The Pokemon phenomena was used as a catalyst for the investigation as the students (aged 10 and 11) described how they used the interrelated nature of the texts to support and scaffold their mathematical understandings. The students demonstrated their capacity to use a range of literacies across a variety of texts to interpret and navigate their way through different mapping contexts. These processes required strong mathematical understanding and the ability to internalise large amounts of mapping-related information across various 2D and 3D representations.

In recent years there has been an increasing recognition of the critical role of representation in learning and understanding mathematics (Cucuo & Curcio, 2001; Goldin, 1999). Although technological advances have heightened the importance of the need for a more dynamic interpretation of the ways information is represented, few studies have considered links between numeracy and representation (Ehrenberg, 1977; Pugalee, 1999) or the multiliteracies required for such interpretation (Clancy & Lowrie, 2002). Given the significance of visual representations in a technological age (Kimbell, 1996), it is important to know how students encode and decode the information graphics that are used in everyday life. Moreover, it is essential to recognise that these interpretations often require more than the ability to use the visual mode of making meaning. It is also necessary to consider the range of literacies that are interrelated within these learning contexts when students engage in the interpretation of these forms of texts. In today's society students regularly use a range of multimodal texts to make sense of the world around them (Cope & Kalantzis, 2000). These texts use a range of design elements and require the use of multiliteracies, which include interpretation of linguistic, audio, gestural, and visual designs.

Numeracy, Literacy and Popular Culture

We cannot afford to ignore the role of popular culture texts in children's lives (Giroux, 1999). These types of texts are the foundation of the entertainment business and they are controlled by multinational companies who are driven by the need to generate profit (Wasko, 2001). Given the fact that children spend large slabs of time with these texts, it is important that time is spent researching the learning that is happening outside the classroom. Since many of the texts make use of increasingly sophisticated forms of graphical representations, high demand is placed on various forms of visual and spatial numeracy. Moreover, there is a blurring of numeracy and literacy demands as such texts also require high levels of written and verbal linguistic understandings. When pop culture texts are considered as serious contexts for learning then regular classrooms can become more inclusive for all students. Learners can then begin to understand that the numeracies

and literacies they have already acquired outside school contexts are transferable and valued and they can be supported in developing a critical stance in relation to the texts they use.

Relationships Between Visual Reasoning and Game Playing

In recent years some associations between visual reasoning and engagement in ICT-rich environments have been established. Amory, Naicker, Vincent, and Adams (1999), for example, found that students preferred to play with 3D adventure games that required the use of visualisation. The interpretation of graphics displays challenged the user to employ a range of problem-solving skills that have strong ties to numeracy development. Yuji (1996) concluded that although children who played computer games on a regular basis did not possess higher spatial discrimination skills than children who seldom played such games, they were able to perform these tasks much more quickly.

A central concern of the present study is to determine the extent to which students are able to interpret directional and position maps which are typically presented in multiple representations. Nemirovosky and Noble (1997) argued that visual representations "in the mind" take place when using a tool requires the user to analyse external images. The development of these external images may enhance an individual's ability to engage in a variety of multimodal texts.

Method

Two students participated in the study. The two boys (aged 10 and 11) were observed over a three-month period as they made meaning when engaged with a variety of multimodal texts. These texts were directly associated with the Pokemon phenomena and included information books, playing cards, computer games, internet sites and games (for example Game Boy, Pokeball). The boys frequently used all of these multimodel texts and played with one another on a regular basis. The participants formed part of a cultural group where members regularly engaged in social interactions based around the use of various Pokemon texts. The central focus of this investigation was to explore the ways in which the individuals made sense of maps when using the electronic Game Boy but also includes insights into the influence other texts had on their numeracy understandings.

Students were interviewed as they played the game. Audio-taped recordings were analysed with follow-up questions posed in order to clarify the students' ideas and thinking processes. The researchers did a search of the internet cheat sites and studied the hand books in order to gain insights into the various forms of text used by the participants to play the game.

This inquiry uses an "instrumental case study" (Stake, 2000), which is a technique that can be used to advance the understanding of an external interest. In this case the participants were chosen because they were able to give the researchers access to the discursive practices of the Pokemon phenomenon and to illuminate their understandings about the numeracies and literacies needed for young players to successfully engage with Pokemon texts. Through using such a case study analysis the researchers have been able to theorise the numeracy and literacy practices of the students, in relation to examples of the complex multimodal texts that are becoming part of their everyday contexts.

The Game

One of the key aspects of playing the Pokemon Game Boy is the notion of journey. Each game involves having a mission that involves going on a Pokemon journey in order to collect different species of Pokemon. These journeys require the players to move across a range of landscapes. Over time the game continues to evolve and so players constantly need to seek out information from the different forms of text. For example, as the game moved to the gold and silver versions the world of Pokemon grew to include The Western Territories, just west of Pallet Town (which is already known from the previous levels). This is Johto League territory, where players have to use their previous mapping knowledge to get started in the new territory. As well there is information particular to specific places on the maps. Bloomingvale is well known for the Sunflora Pokemon, the people of Cherrygrove don't like their wild Quagsire being caught by trainers, while Charicific Valley is where you find the wild Charizard. Students need to know where to go, how to get there and what they will encounter, so they can be prepared, or, if they are after specific Pokemon then they know where they can go to look for them.

Data Analysis

The criteria identified in Table 1 are categorised under the headings of a) general knowledge of maps; and b) specific mathematics understandings; and c) multimodal dimensions. Lowrie, Francis and Rogers (2000) used the first two categories to compare and contrast young students' knowledge of maps and spatial understandings when engaged in open-ended problem-solving contexts. The present study reflects changes in the notion of mapping that have come about through the use of popculture multimodal texts, texts that require a range of literacies, if users are to make meaning from their engagements (Clancy & Lowrie, 2002). The multimodal texts that form the basis of this study all relate to the Pokemon phenomena. By offering players dynamic ways of interacting with maps these games enable players to refine their present knowledge and to develop a range of new and different ways of making meanings from their use of maps, and as a consequence increase the sophistication of their mathematical understandings.

Table 1
Criteria Used to Assess Students' Responses

General knowledge of maps	Specific mathematics understandings	Multimodal dimensions
Landmarks	Understanding of scale	Graphics
Key	Language related to Position (Directions Coordinates)	Navigating in dynamic contexts
Symbolic representations		"Inside" and "outside" space
"Birds eye" [plan] view	2D representation	
	3D representation	Complex nature of multimodal text forms

Results and Discussion

When the game begins the players are required to move across a range of landscapes. Mark and Ric explained that in order to do this, maps (which provide a 'birds eye' view of the landscape) of these areas are available in different places, for example in the handbook, or as an integral part of the game as it is being played (they are part of the *poke gear* available for each game). The participants also noted that they used internet cheat sites and the handbook. Mark also commented that in order to gain extra information you needed to play the game and have conversations with friends who, "tell you about parts of the map before you go to battle." The knowledge they gained about maps was cumulative and internalised over a period of time. At one point, when asked about how he knew where to go, Mark replied "cause I've played before".

Both boys are familiar with the games and are well aware of the journey process and the opportunities and constraints embedded within this process. As Mark commented:

> … you go to Professor Elm's office to collect a Pokemon as your partner you can't actually leave this town until you get your Pokemon.

As they played, they gave us a running commentary of the process involved in achieving intended goals.

> Now he's about to send us off on a mission with our Pokemon, to go find his friend Mr Pokemon, and then he'll give us a mystery egg that we have to bring back to him.

As this is happening the player is represented on the screen and the boys used the arrows to move the trainer around the town to the different places he needs to go before setting out on the journey. While they continue moving, they are required to interpret various representational aspects of the map including general knowledge of maps and specific mathematical understandings (see Table 1). As they played the game they made comments in relation to landmarks and other symbolic representations such as:

> That black line is a ledge. You can't go back through them because you can't climb up them, but you can jump over them…that's long grass, that's where Pokemon hide, and behind the trees. The white is a path and there are gaps and ledges and use the arrows.

Their general knowledge of maps is demonstrated through the ways in which they clearly understand the significance of different locations and the ways of moving between these. Their explanations show that they can make their way through the "bird's eye" view of the streets and mazes and that they understand the symbolic representations within these landscapes.

Interestingly, an ability to navigate through the landscape and make spatial connections is not always sufficient in order to purposefully move to new locations. Players also need other "game skills" which are used in conjunction with spatial understandings to move their player through their journey. For example, Ric spoke about the Indigo Plateau which is described as When the screen becomes dark, we are informed that it's not night-time, but that we are actually in a cave. They then point out what they describe as:

> The Champion League…the place where all the really tough trainers go. It's the ultimate battle area. You have to win against the Indigo Plateau after you get eight badges, that's the only way to get to a new area.

A little later in the game, Mark gave quite a detailed explanation of what had to be done once you had a GS Ball (the most mysterious of the pokeballs which are used to catch new Pokemon).

> You take the GS Ball to the shrine in Azalea Town, in the Ilex Forest and put the GS Ball on the shrine and you'll find one of the legendary dogs.

In this comment Mark demonstrated an ability to use and interpret specific mathematical ideas associated with positional language in order to describe key landmarks. It could be argued that he was able to employ some fairly sophisticated visual strategies "in the mind's eye" to describe pathways through the game. Moreover, he was using dynamic imagery (Presmeg, 1985) to move between frames on the screen that could not be simultaneously viewed in order to make judgements about pathways and desired locations.

Significantly, some of the solution paths described by Mark were obtained from internet cheat sites to which both players constantly refer rather than actual game experience. These sites are full of complex instructions that require players to be consistently navigating their way through dynamic contexts, understanding directions, interpreting symbolic representations while keeping a close eye on the graphics, which may change slightly to alert the player that something else is about to happen, such as a tree or bush moving slightly or the screen starts flashing white/normal and then a pokeball comes up with a sound. An example of these instructions highlights the complexity of the positional language and mapping relationships required within the game framework.

> …go to Ecruteak City, then go inside he second cave (second entrance to Mt Mortar) turn to the right and Surf. Go to the top and enter the other cave that is there. Make your way around the mazes and talk to Blackbelt Kyo. Defeat him to get Tyrogue/Buruki. (http://www.cheatcc.com/gb/pokemongs.html)

Instructions written in this form demand players exhibit a high degree of linguistic comprehension and a sophisticated approach to knowing and understanding about maps. Other sites provide a list of all the places on the maps, and an explanation of what to expect to happen at each of these. It is interesting to note that all instructional sites visited were presented in a written format. There were no graphics or maps to enhance the explanation. Information in this format means players then have to link this with the map that is in another place. For example under the heading of Pewter City, players are told:

> This is where Brock lives. At his command are Onix and Geodude, two rock-type Pokémon. Old Amber is in the museum. In order to enter the side of the museum, you need to cut a bush with the cut ability. Old Amber will become an Aerodactyl when you take it to the Pokémon Laboratory on Cinnabar Island. Before you go into Mount Moon, go to the Pokémon Centre near the entrance and find the man that will give you a Magikarp for $500 (Pokemon PlayGuide, Pewter City). (http://www.geocities.com/RodeoDrive/Plaza/1827/playguide1.htm)

Consequently, the degree of internalisation required to link the static verbal instructions from the sites to the relatively dynamic screen displays demands highly sophisticated visual and linguistic reasoning. Furthermore, various forms of graphical languages (Mackinlay, 1999) need to be interpreted and acted from different sources (i.e., the computer game and internet site) in order to develop such descriptions and visual images.

The actual processes required to interpret the maps are multimodal in nature—in the sense that different forms of text not only inform the decision-making process but also influence the players' perception of how to interact within the game context. The

participants often made reference to the fact that they were the Pokemon trainers as apposed to a more general view of being external to the game. Kosslyn's (1983) notion of "inside" and "outside" space can help explain how the players interpret these maps. When Ric commented that he "feels like his is in the game moving around" the defined boundaries being interpreted are confined to the maps within the computer screen. When he considers other texts and information to make decision his imagery moves beyond 2D-3D relationships on the screen (outside space). As the journey moves across the landscape and into completely different locations other forms of dynamic imagery (Presmeg, 1985) are evoked.

Specific Mathematics Understandings

Although the players did not directly refer to positional language related to compass bearings while actually playing the computer game, it was evident that they had internalised such formal positional understandings in the way that they were able to navigate purposefully to achieve the goals of the game. The knowledge of compass bearings is an integral part of the information that they regularly access through the internet cheat sites. For example, the instructions required to find Pokemon at Cerulean City tell players to:

> Go East and cut your way through. Go all the way East and then South, making sure to beat all the trainers in the way. You will then see the Rock Tunnel. Make sure to visit the Pokemon Centre before entering through. (http://www.geocities.com/RodeoDrive/Plaza/1827/playguide1.htm)

The players acknowledged that the reason they knew exactly what to do at different points in the game was because they had internalised the information from the internet cheat sites. The players indicated that they preferred to use their knowledge to inform their game play rather than "take risks" (employ trial-and-error strategies). Such behaviour provided evidence that they were making informed decisions about their navigational processes rather than randomly trying to find their way through the maps. Importantly, these processes were internalised in a visual manner before being put into use. Although the boys are now experienced players and they move through the game rapidly they admitted that when beginning they were much slower at processing the information they required and that they frequently had to return to the cheat sites in order to validate their ideas. As their knowledge of the game increased, they were able to develop more detailed and dynamic images that could be acted upon without the reinforced support of the verbal components.

Conclusion

To engage with the processes described here, the participants used a range of modes to make meaning of the maps they are using. They interpreted linguistic, audio, visual and in particular, spatial design to access a range of information that enabled them to effectively use the navigational tools that are provided to support them in their game play. Due to the multimodal nature of these materials, the participants were required to interpret maps in dynamic ways, providing opportunities for the "maps that come alive."

The students used a range of general understandings of maps in order to make sense of the game. These understandings included an awareness of how symbols were represented on the screen and an ability to recognise landmarks based on information from several

sources of text. Some of this information needed to be internalised and transferred to bird's-eye-view representations. Specific understandings of mathematics in new contexts were also required. One of the most challenging aspects of the game play involved the players interpreting detailed positional and directional information (including compass bearings) and using that information to navigate through dynamic maps. Interestingly, the multimodal nature of the game encouraged the students to move between "inside" and "outside" space to interpret information. The participants were highly motivated and engaged in relatively sophisticated aspects of spatial reasoning in an environment they found meaningful. In many ways the students learning could also be considered authentic because they were able to relate their learning to so many aspects of their daily lives.

Implications

This study only addresses a small component of the kinds of numeracy and literacy learning that is being generated when students engage with the multimodal texts that are an integral part of their daily lives. Nevertheless, the investigation highlights the need for more attention to be paid to the diversity of texts that students are exposed to and the numeracies and literacies that are required in our digital age. The study recognised the multiple skills that students are developing in the home context, primarily of their own accord, as they engage in activities that they find both meaningful and authentic. It also shows the potential such forms of learning can have on student's numeracy development. It seems to be the case that learning communities like the one described in this study need to be more frequently recognised at school as multimodal communications become increasingly relevant to children's needs and interests. Educators should be encouraged to make closer connections to these forms of learning as a way of promoting the kinds of numeracy understandings that will be required as information and other forms of technological communications are presented across a range of visual and spatial displays.

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