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Emergent Practices and Distributed Emotions in Educational Game Play

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Abstract: This paper discusses the learners' encounters with an educational game called *DinoPlates*, which intends to support playful learning for secondary level Earth science concepts. *DinoPlates* simulates and lets learners control the Earth's processes and search for dinosaur fossils. We contend that the emergent interactions observed in playing *DinoPlates* may implicate a potential for liberalizing the social practices of the digital generation through an educational game play. Findings with Singapore secondary male students indicate that different pairs playing the game identified different practices for achieving their emergent goals. We discuss the opportunities that the design of *DinoPlates* affords for emergent interactions in game play, and the ways learners' emotional resources influence their practices.

Keywords: Educational game, distributed emotions, informal ideas, playful learning

1. Introduction

> We have built Everest! We built Everest! We defeated Everest!
>
> *Leon and Justin, during game play*

The types of learning that take place in teenagers' daily use of digital media (e.g., web 2.0, social networking, online games) are characterized by the interplay between unlimited resources and environments to create and experiment; and the growth of their ideas, passion, and agency (Thomas & Brown, 2011). The above excerpt is from a pair who played *DinoPlates* together. *DinoPlates*, an educational game for Earth science learning, simulates as well as lets players control the Earth's processes (i.e., tectonic plate movement and erosion) and search for dinosaur fossils from different geologic time periods. Leon and Justin had created towering mountain peaks in *DinoPlates*, and were announcing their achievement with reference to Mount Everest to their classmates. It gives us a glimpse of their excitement, and a potential growth in their passion for the learning.

The potential for learning with digital games has been of interest to researchers since the 1960's (e.g., Boocock & Schild, 1968), which has continued with different ideas and interests. Papert (1980), for example, created children's programming environment for creating games and building knowledge. More recently, Gee (2008) put forward learning principles seen from game plays and advocated digital games' potentials for education. On the other hand, there has been accompanying tensions between the need for playful learning (i.e., gaining knowledge and skills for better game-playing) and the need for educational values that are expected in school. This paper pays attention to the ways in which learners exhibit social practices of the digital generation, i.e., a new culture of learning (Thomas & Brown, 2011), when they encountered *DinoPlates*. In particular, we are interested in what sparks learners' emotional engagements in their game play that give rise to their ideas, passion, and agency. The work detailed in this paper draws on our implementation in an all-boys secondary school. The analysis was guided by following questions: 1) what kinds of learner interactions and practices emerge during game play?; and 2) how do the learners express their ideas and feelings about their practices? We derived our analysis from the video and audio recordings we collected during their in-class gameplay and interviews. We focus our observation on their interaction as a pair playing the game as well as how they respond and connect with other participants. The examples from our study illustrate the kind of learning that took place through their gameplay and conversations.

2. Emotions, Practices and Playful Engagement

Introducing new objects or new ways of using objects within a community requires its members to transform their ways of doing things, adopt new language, or play different roles outside their community boundaries. In many ways, the new objects may lead to transformation of the community itself (Tsurusaki, Calabrese Barton, Tan, Koch, & Contento, 2013). Digital games can create shared spaces that embody objects from disciplinary practices and transform the practices of school learning. Such possibilities are relevant to how game environments consist of models: they may model complex interactions in social, geographical and political settings as in *The Sims* or *Civilization*, simulate scientific principles found in many physics-based games, e.g., *Angry Birds*, and depict our cultural models about the world (e.g., how hero and heroine should look like, what are good and evil acts) (Gee, 2008; Squire & Patterson, 2011). *Civilization III*, for example, was developed with an in-depth understanding of history, geography and politics, and adopted for social science curriculum, which transformed the ways students interact and discuss about the civilization history (Squire, 2005).

When the modeling of a digital game is focused on the meanings of a disciplinary community, players may learn the community's skills, values and knowledge, and identify with the community. One of the Shaffer's (2006) epistemic games, Urban Science, models the contexts and problems of urban planner. This requires the players to behave like a professional planner and solve problems through research, consultation and mastery of a particular vocabulary. Such models and modeling embodied within games engage players in thinking and problem-solving of the disciplines. Focus on a real problem is an effective way to learn deeply about the subject and to own the scientific process (Klopfer, 2008; Scardamalia & Bereiter, 2006), which is a first step to think and act beyond the school boundary and to connect with informal ways of learning, i.e., social practices, with school learning.

We contend that the emergent interactions observed in playing *DinoPlates* – as opposed to planned/designed activities – may implicate a potential for liberalizing the social practices of the digital generation in formal school settings. Such interactions emerge and implicate learners' practices while socially situated in a particular learning and playing context. Playful learning is one of the important practices of the digital generation: it highlights learners' experimenting with their surroundings and embracing new things and changes, through which they invent and solve problems and advance their knowledge and skills (Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2007; Thomas & Brown, 2011). Conceptualizing learners' interactions from the perspective of their emergent practices (cf. McCaslin, 2009) enables us to examine their actions and conversations in a meaningful manner. We use the word, "emergent" as being prominent at a particular situation.

Central to this interplay between play and learning are learners' emotions. Learners constantly appraise what is presented in the game and act accordingly (Eynde & Turner, 2006). Learners' ideas, emotions, and actions are sociocultural practices that often emerge in context. Learners' emotional engagement truly become their resources for playful learning: when learners find personal meanings of their activities, their emotions could direct their attention toward them (B. Kim & Kim, 2010; Pekrun, Goetz, Titz, & Perry, 2002). Learners' different ways of being and doing things are enacted in different settings and may shift depending on the situational demands (Gee, 2010; Roth et al., 2004), which are most likely accompanied by various emotions. In the following, we examine learners' expressions that indicate their emotions as resources for their emergent practices, and thus indicating their playful learning. Their emotion-bound personal meanings are implicitly played out by learners themselves in this particular gaming context and affect their practices with the game. We start by describing the design of *DinoPlates* and consider how it affords for emergent interactions in playing the game. Based on what we observed from the video recordings, we then discuss the emergent practices and the ways in which learners' emotional resources influence their practices.

3. Context of the Study

This study was part of a long-term collaboration between a university and an all-boys secondary school in Singapore. Some teachers and students of the school were involved in the design and implementation of the previous earth system science educational game prototypes. The game evolved in stages by involving learners and teachers as design partners in five progressive informant design workshops (Kim, Tan, & Kim, 2013), and *DinoPlates* is the latest game prototype.

3.1 *The Game: DinoPlates*

DinoPlates models convergent and divergent movements of a tectonic plate, layers of rocks, patterns of dinosaur fossil discovery (e.g., elevation, rock types), and natural forces that change landscapes (e.g., erosions by wind and rainfall). *Dinoplates* requires players to consider where and how fossils are exposed for their fossil search, which is similar to how paleontologists work. The development of *DinoPlates* incorporated learners' design ideas. In our informant design workshops, learners often designed quests involving plate tectonics: using tectonic forces as their power to achieve goals in the game (e.g., creating mountains, triggering volcanic eruptions) was the key component of their quest ideas (Kim et al., 2013). Our design incorporated learners' design ideas as well as our principle of situating concepts and knowledge within the disciplinary practices. Meaningful contents and activities support playful learning practices in educational games and help learners to engage their emotional resources for school learning and practices (Kim & Kim, 2010). Players directly affect the landscape to create mountains and erode lands and hills. Modeling plate tectonics is not an easy design task, not only for the complexity of the process but also for its vast scales of time and space. How to both model these processes and make them visible to players was an important issue in our design of *DinoPlates* (see Figure 1).

a) Plate landscape b) Detailed view

Figure 1. *DinoPlates* game interface

In *DinoPlates*, each player has a tectonic plate: one side is a convergent tectonic boundary (thus rising and forming mountains) and the other side along a divergent boundary (thus fracturing and decreasing in elevation over time) (see Figure 1a). The plate has a total of 10,000 squares. In Main View, the plate is a 10 x 10 map of grid squares, each of which in Detailed View expands to another 10 x 10 grid. Each square is many layers deep, comprised of different rock types and geological periods. Players have access to topographic and geological maps, and they can explore specific grid squares of the plate. When a player clicks on a square in a detailed view, the game displays information about the top three rock layers (rock type, geological age, thickness), and the player is given the option to dig for fossils there (see Figure 1b).

Players complete mini-quests and receive badges in *DinoPlates*. They range from simply reading the geological map; to finding a fossil at an elevation over 6,000 meters; to building a mountain over 10,000 meters high; to conquering a geological time period by discovering all the available fossils from it. Players can only dig the top layer of a square, so they must work to expose the desired rock layers. To do this, they can purchase and use various forces that modify the landform: winds and rains of various strengths, and convergent and divergent tectonic forces. They are deployed in units of many years to yield visible results in the game. Players earn coins and points as they excavate fossils, and the badges they earn enable them to complete the game.

3.2 *The Study: Playing DinoPlates*

The subjects of our study were a cohort of 12 to 13-year-old secondary one (grade 13) students in an all-boys school. Four classes played the *DinoPlates* prototype during supplementary geography lessons, and we gained informed consents from only some of the students from two classes to allow us to study their game play. The sessions covered two periods (90 minutes) per class. Before allowing the students to enter the computer lab, the teacher asked them to find a partner to work with. They were paired to encourage discussion among themselves. In total, we collected data of 21 groups from two classes. The students collaborated in pairs with an exception of one group with three boys.

The teacher first had them sit away from the computers in order to brief them on the objectives of the session (i.e., experiencing and experimenting with various knowledge and skills from their geography lessons) and orient them with some open questions. He displayed the items from the *DinoPlates*' Store and discussed with them what could happen with such forces (e.g., heavy rain for 10,000 years). He then showed the introductory video that highlights the features of the game. Each pair was given a worksheet, on which they could record data on their fossil searches and changes in landforms. This activity with the worksheet was intended to create resources for their reflection and discussion after the game play. Their game play and group activity lasted about 40 minutes, including the time spent on starting up and creating their account. As we designed this prototype to be completed in about 60 minutes, students were encouraged to continue the game at home. The teacher gathered them again in the open area away from the computers and proceeded to debrief the students. The discussion was focused on what they observed, what they thought was happening, why they thought they were able to find certain fossils in certain areas, and what other questions they had around the fossils, rocks, and landforms.

The game design intended players to use the embodied knowledge within the game, which include rock types, plate movements and land formation, and properties of rock layers and fossils. We expected the players to engage in both gaming practices (i.e., examining and strategizing for quests) as well as disciplinary practices (i.e., examining location indicators in determining where to find fossils, evaluating layer and fossil properties, and using earth changing effects to facilitate their fossil search based on their understanding of fossils, layer properties and landforms).

3.3 Data Collection and Analysis

Video data was captured during the course of these sessions. The team set up the computer lab with individual webcams and screen capture software in advance. The recording captured students' expressions and discussions together with their in-game interactions. After initial analysis of the video recordings of the game play, we interviewed students by watching and having conversations around the video recordings of their game play (7 pairs and 1 group of 3 students). As an exploratory study no specific themes were pre-conceived in the initial phase of the analysis, but the following questions guided our anlysis: 1) what kinds of learner interactions and practices emerge during game play?; and 2) how do the learners express their ideas and feelings about their practices?

The observation notes and video data were initially chunked into meaningful episodes and activities (i.e., logs) adopting the interaction analysis method (Barab, Hay, & Yamagata-Lynch, 2001; Erickson, 2006; Hay & Kim, 2007; Jordan & Henderson, 1995), to identify critical events, flow, and shifts in the process. Drawing on the logs, we started to look for themes and patterns, discussed them between the two researchers, and returned to the data for verification. We compared and contrasted the ways in which various components of the games were taken up by the learners in these events (Glaser, 1965; Strauss & Corbin, 2008). We examined how the learners were creating meanings and expressing their ideas, which indicate their existing or shifted ways of communicating, doing, and being in this particular context (Gee, 2010). Their interactions with the game and each other allowed us to identify categories useful in understanding how they relate to the game and also the practices they introduce to make the game more meaningful to them.

4. Emergent Practices and Distributed Emotions in Playing *DinoPlates*

Playing a game during school time provides a unique situation whereby the learners may constantly move in and out of the various practices (i.e., gaming practices, out-of-school social practices, and school practices). Out of the eight groups we observed as well as interviewed, we chose two groups (two pairs with pseudonyms) to discuss two of the themes to be presented in this paper. These two groups represent how learners mobilize informal ideas while searching for fossils and how they pursue situated and emergent goals during game play.

Danny and Zheng Yi are from an academically weaker class within their cohort. The school, however, is one of the higher ranked schools in the country. Zheng Yi came to the interview alone because Danny was not well on that day. Zheng Yi personally plays Team Fortress and Minecraft, and he pointed out that Danny plays Blackshot. He plays computer games for about 30 minutes to 2-3 hours a day depending on the time of the year (he plays less during exam time). He thinks Danny plays many other games everyday and is very good at them. It seemed that Danny knows he is better gamer than Zheng Yi: he called Zheng Yi a “noob”, when he made a mistake during game play.

Leon and Justin are from another class, which is considered a “high achievers” class in their level. They both mentioned Backyard Monster (a Facebook game) and Minecraft as games they play. They named their tectonic plate Korath, their favourite monster character from Backyard Monsters. They described Korath as a creature made of magma and covered by pieces of rocks, but they did not intend to associate it with the characteristics of the game.

Our analysis was focused on their actions and discourses that were emergent and not necessarily intended by our design of the game. The findings indicate that different groups identified different practices for achieving their emergent goals. We discuss how students approached their search for fossils, and how their goals and practices emerged during the game play. For each theme, we first discuss the general pattern emerged from various groups, and then provide an illustrative case from one of the groups described above.

4.1 Approaches to Fossil Search: Mobilizing Informal Ideas

We witnessed a range of modus operandi employed by the students to achieve the goal of finding fossils. They include relying on the information on fossil probabilities, looking for the appropriate rock types using the rock distribution map, finding target area to change the landform, digging as many places as possible (trial-and-error), or combinations of these. The most often seen strategy is reading the values of “fossil probability” presented in a table of information before they click on the “Dig Here” button. Figure 2 shows the information box, it appeared when a pair clicked a tile in an area (coordinates 12, 44). Each row shows a layer of the rock with their properties, and the line drawn across the window is the trace of mouse movement.

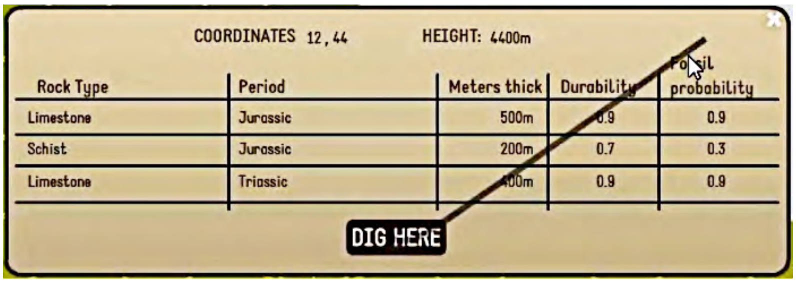

Figure 2. Pop-up Box for Digging a Tile

Fossil probability value of 0.9 in the top layer indicates a strong possibility of fossil finds from Jurassic period, which is also relevant to its rock type (i.e., limestone). Many students relied on the reading of the fossil probability to locate fossils as a way of deducing the fossil presence. Other information in Figure 2 includes the thickness and durability of the layer, which are useful if they are interested in eroding the layer to reach the next layer. Some students indeed added another step by using some earth-changing effects (wind and rain) that was followed by an excavation of fossils in the deeper rock layer.

For Danny and Zheng Yi, examining the fossil probabilities was one of the possible means for their fossil search. Earlier in the game play, they went into the shop after earning some coins with a mini-game instead of spending the coins to dig for fossils. Zheng Yi controlled the mouse most of the time, and Danny told him to buy Rain Monsoon (strongest and most expensive among different types of rain effects). They discussed about Divergent force, but Zheng Yi bought Convergent force. Looking at the items they had, Danny initiated the idea of using the convergent effect to create mountains and then apply the rain monsoon effect to cause a landslide to expose fossils.

Zheng Yi : ((enters the inventory menu to check on the earth changing effects they purchased: Rain monsoon and convergent tectonic effects are in their inventory))
Danny : ((laughs)) You, you, you convergent right, then you (form) one mountain, then you (dig) bones.
Zheng Yi : (use) rain monsoon.
Danny : No, ((laughs)) you, you put convergent, make it damn high first, then you go put rain monsoon, landslide all the way.
Zheng Yi : Explore this ((chooses an area in the main view to explore))
Danny : You should put it here ((points at an area on the monitor screen/main view)), then you like monsoon all (the things).
Zheng Yi : (This one) monsoon (here)
Danny : No. You convergent first, then everything *damn high* ((hands gesturing a mountain peak)) ((laughs)), then you rain monsoon, then *whole thing* fall.

Danny and Zheng Yi were not articulating fluently when they were describing their strategies to expose fossils. We, however, can see that Danny constructed his logic by adding elements to his explanation as he tried to convey his idea to Zheng Yi several times. Danny initially only had the idea of forming a mountain to find fossils, and then he added rain monsoon effect when Zheng Yi mentioned it. In the end, in order to better express and simulate what he was imagining, he used his hands to gesticulate the peaking and eroding mountain. Although he did not express much at that time, Zheng Yi seemed to be mobilizing his informal ideas and knowledge on how the earth changes. He explained their approach as following during the interview:

> We used convergent and rain effects because the effects are *more drastic*, like more changes… Because we tried, and it ((rain)) seems to clear more lands so we want to use rain (to clear quickly), and convergent to show us more ((fossils)). In class also learn that. Water will *erode faster* than (wind)… It's to show the bottom of the surface ((the lower layer of the plate)), because the bottom (pushed up on top then washed) down, I think… (First) convergent, then wash down so that, even *more exposed*.

Danny and Zheng Yi’s approach seems to demonstrate how some students were able to use and experiment with their own informal ideas and prior knowledge on how fossils are exposed and how the land goes through changes. Such informal ideas are the most important resources for their learning (Kim et al., 2012; Kim et al., 2013), and we see the potential of their everyday learning practices being brought forward while playing the game. At the same time, learners expressed the prospective simulation of the game and its earth changing effects (i.e., representations) with words that emphasize on what they imagine as exciting changes (i.e., drastic changes, emphasis added in the excerpts above). Danny’s persistence in expressing the earth’s processes reveals how closely he is connected to his own ideas. It illuminates how Danny anchored his emotional relationship with the content (i.e., being able to experiment with his own ideas) and with representations to be processed based on their choices (i.e., mountain formation and erosion).

4.2 Situated and Emergent Goals

Playing an educational game with their peers in the school computer lab certainly provides a very different atmosphere from a teacher delivering a traditional lecture in their classroom. It is different from their out-of-school gaming situations. Learners in this situation are constantly navigating among the various contextual cues as gamers, playmates, and students, and we observed that their personal goals emerge in the course. Such emergence especially came with students’ experimenting with their ideas, not only to find more fossils (as in Zheng Yi and Danny’s case) but also just to see what happens with the simulated environment in *DinoPlates*. A pair, for example, tried to excavate the sea area to test the possibility of fossils in the waters: the game offered a safe space for the players to experiment. In another group we observed, one of the boys was trying to influence his partner, who is on task with fossil searching, to join him to create mountains after seeing the “Build a 10000 meters Mountain” icon on the Quest bar. As they go along, their game trajectory included the purchase of more convergent effects to create mountains. Such emergent goals are triggered by different events for each group, as they were playing the game and interacting with their peers, the teacher, and researchers.

For Leon and Justin, their goal of creating a mountain emerged when the teacher commented on what they did in the game. When the teacher was walking by their computer, he observed that their landscape was dominated by a massive mountain:

Teacher : What monstrosity have you created? ((referring to the massive block of mountains formed in their landmass, see Figure 3)).

Justin : ((controlling the mouse)) Huh?

Teacher : It's huge.

Justin : I know. (Found) it.

Leon : ((giggling)) Monstrosity… ((continue giggling as the teacher walks away)).

Justin : Maybe you know (where it is). ((In the main view, they maneuver the frame and position the group of mountains to the fore)).

Leon : Eh, do some more.

Justin : ((selecting and exploring an area by the mountains)) I am going to try blowing up, you know, the tall area? Yah? I am going to try blowing it up.

Leon : How?

Justin : OK, let's… ((entering the Inventory menu, choosing the Convergent tectonic effect, and draging the effect to the mountains)).

Leon : Yah, dump it there, dump it there.

Encouraged by their teacher's comments, Justin and Leon set off to create more ambitious ones. They employed convergent tectonic effect generously on the mountain to cause it to elevate further. This self-driven task was performed with much pleasure as both Leon and Justin "conspired" to create something of monumental scale. They spent the next few minutes applying more convergent forces on the plate, which triggered more effects on the land mass (i.e., stronger convergent forces on the grid squares they chose subsequently causing other parts of the plate to converge and raise higher).

Figure 3. Justin and Leon's Korath Plate

In the next excerpt, Leon had dragged convergent tectonic effects onto the mountains. They are waiting for the results of the effects indicated by exclamation marks. At times, the game will generate effects and exclamation marks automatically without the need for players to plant any effects on the grid squares. These exclamation marks when activated, display information on the type of natural phenomenon that has occurred. Blue exclamation marks would show up and blink to alert the players to click on it when certain events had happened (e.g., erosion of the landmass or convergence of the plate by the player's application of effects or by the system's simulation). When they clicked on a blinking exclamation mark, it announces that rain monsoon had taken place:

Justin : Oh, no, no, no, that one is a natural one. Wait for one of those (we put). ((waiting for the Convergent tectonic effect timer to complete the count-down)). ((A blue exclamation mark appears randomly to convey a natural event taking place.))

Justin : Eh, another one. ((the blue exclamation mark)).

Leon : See, one. ((clicks on the mark, and it disappears)) Eh, what's wrong?

Justin : Just wait, just wait. ((A box pops up congratulating them for accomplishing a task of building a 10,000 meters high mountain in five minutes and earning 1000 coins))

Justin : We have built a mountain.

Researcher: Oh, built a mountain. You have finished. ((Leon giggles)).

Justin : Whoaaa… ((Leon starts to giggle louder when they change the view revealing a taller mountain)) *All those convergence really work.* ((Leon laughing)). *All those convergence really work.* ((two other convergent effects they planted turned to blue exclamation marks consecutively and Justin clicks on them)).

They were ecstatic when they built a 10,000 meters tall mountain, and continued to put more convergent tectonic forces. As they saw more mountains were peaking up, they invited other friends to witness what they had created and announced that they built and defeated Everest. When we asked them about it during the interview, they said,

Leon : It's actually a mountain because of the convergent plate. Then they were folding and creating a large mountain. And later on, we actually decided to, like, make it bigger… 'Cause, Mt. Everest's supposed to be the tallest mountain so we wanted to make it even taller than that… The time was almost over so we tried to have a bit more fun with the (world) and so we actually just built this gigantic mountain and then after that... with reference to Everest.

Justin : ((They used more convergent effects because)) just curious to see what would happen. See how, how it can be… We spam on it ((convergent boundary))…'Cause we did what we wanted to do, (so we were) having a bit of fun ((with regards to announcing Everest)).

Leon and Justin introduced their personal goal into their game play when they decided to apply multiple effects in a single area. This kind of motivation to explore and create can become a powerful resource for playful learning during the game play. When they are engaged to complete personal goals, they are empowered by their decisions, and their accomplishments become personally meaningful. Such endeavours we saw from Leon and Justin are highly situated and emergent in this particular context: there was a limited play time within the school's curriculum schedule, there were adults who acknowledged their accomplishments, and there were other classmates whom they could share their achievements immediately. In contrast to Zheng Yi and Danny's account, Leon and Justin's emotional relationship (i.e., excitement expressed through their giggling and laughing and their words of awe) is associated with how the game created the representations beyond their expectations, how their teacher and their classmates respond to the changes, and how the concepts (i.e., convergent boundaries and how high mountains in the world formed) existed in texbooks came into play.

5. Discussions: Evaluating Objects, Environment, and Accomplishments

What we have discussed above is the glimpse of the possible interplay between their play and learning. There were variations in students' approaches to fossil search, but mobilizing their ideas and experiences as students and game players was a common practice among different groups. Their goals and practices emerged within the context of game play and also indicate an interplay between formal and informal practices: students were focused on their practice of playing and experimenting with the game, but at the same time were amused and excited by the events occurred in the game and the social activities they engaged in with their friends.

During the game play, many of the pairs working together compared and announced their achievements with their classmates around them. Their actions informed us that they were sharing information on what they were doing and at the same time inviting their peers to join similar practices. They looked for indicators of their status as game players and introduced competitions among them. Leon and Justin, as discussed above, were very excited to announce their accomplishments, when they said, "We *defeated* Everest." Such status enhancement and competition were within their game play (i.e., defeating Everest) as well as with their friends around them. They are able and empowered to create, discover, and evaluate various indicators (e.g., the highest mountain in the world, the properties of dinosaurs they find) by creating their personal and social goals situated within this context. Similar youths' coveting for status and ranking through new media production, games, and social media was described by Ito and colleagues (2010), whereas student initiated these elements into the formal space in our context.

Playful learning is one of the important practices of the digital generation: it highlights learners' experimenting through their actions with their surroundings and embracing and familiarizing new things and changes, through which they invent and solve problems and advance their knowledge and skills. Two pairs in our illustrated examples above have shown their capacity to experiment and invent. Central to this interplay between play and learning, lie students' emotions. As discussed above, Leon and Justin were experimenting with the game environment to explore how the convergent effects work as well as to have "fun", and giggling and laughing were common in their group play. While developing his strategies to expose fossils in the game, Danny connected the mountain formation and erosion processes with his approach and described it to his partner, Zhengyi with much laughter and conviction. Such emotional engagement truly become their resources for playful learning (Kim & Kim, 2010), and it shows the learning potentials and design implications for an educational game that can invite their practices of play. For Leon and Justin, their interview revealed that their game play continued at home and triggered them to search and read more information about the dinosaur fossils they found.

Playful learning also involves evaluating their artifacts and actions, and expressing their judgments through their words and actions. When Justin told Leon, "Wait for one of those (we put)" for their convergent effects, they value their actions they performed earlier on the game rather than effects automatically created by the game. In the exchanges not reported in this paper, Danny and his friends compared fossils they found and they wanted to know if other groups have found fossils of a whole dinosaur rather than parts (e.g., tooth, claw, jaw). Learners also evaluate their own actions and express their judgments when they play. For examples, Leon and Justin called their action of putting many convergent effects as "spamming", expressing the value they see for such actions. For Justin and Leon, the words used in action (e.g., fighting and shooting) games seem to express their excitement and emotional attachment to their current game interactions. When they decided to build high mountains, Justin told Leon that he would try "blowing it up." Leon, on the other hand, excitedly announced to his friends that they have "defeated" Everest, as they know that it is the highest mountain in the world. By using such informal terms of play to describe their actions, learners situate themselves in a playful mode within a formal school setting.

6. Conclusions

We recognize and emphasize that what we observed above are highly situated in this context: (1) the game play was with a classroom full of boys, many of whom are experienced with playing games; (2) there were tasks given by the teacher and being created by themselves; and (3) their classmates as well as the presence of the teacher and the researchers constantly influenced their interactions. For example, instead of chastising and regulating their overzealous excitement in the formal space, the teacher played the role of a "co-conspirator" (Ito, 2010), rousing Leon and Justin's interests with his comments encouraging them to make advancements in the game. This spontaneity seen in students may say something about classroom teaching and the potential of setting up a nurturing learning space. In our case of educational game play, learners' emergent interactions as students, playmates, and gamers can all be productive in their learning efforts, in which they use their informal ideas, negotiate for their ideas and roles within the group, create personal goals and competitions, find ways to have fun, create and solve problems together, and seek recognitions and confirmations from the teacher and peers. Learners' playfulness and excitements were expressed through their actions and terms they used. We believe that the skills required in the new media culture (as discussed in Jenkins et al., 2007) are used in our learners' everyday social practices and that we need to provide learners with the opportunities to recognize their own legitimate ways of learning and use them well in the school contexts. We hope that our on-going efforts provide design implications for engaging learners in playful learning potentially liberalizing their social practices of the digital generation.

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