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Finding Voices and Emerging Agency in Classroom Learning

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Abstract: This paper describes the development of a class as a learning community that transits from one established classroom practice that elevated monologic voices of authorities to another practice that encouraged dialogic participation. The project illustrated in this paper took a design-based approach in nurturing a learning community in a classroom, with which we re-designed the Secondary 1 Geography curriculum with teachers around six design principles. This paper proposes that the effort of a teacher, Nicole, helped learners find their inner persuasive voices and developed their conceptual agency in learning Geography. The transition of Nicole's Geography class is examined by comparing episodes from different periods of the project implementation, with the goal of finding out how students' agency emerges from this transition.

Nicole: 24 hours (referring to North Pole's time without daylight). Ok, now looking at this, when do you think the date would be? Which month would this occurrence happen?

Student 1: December

Nicole: December? Why December here? Why, why not...

Student 2: 'Cause the video says so.

Student 3: Because the book says so. *(During a lesson on 'Day and Night', 21 Jan 2010)*

Nicole: We're going to hear Luke and John (students) explain to the class. Hopefully they are better teachers than Mrs. Toh (herself) who will not confuse you. Can?

Student 4: What if they confuse us even further?

(During a lesson on 'Atlas and Grids', 9 Feb 2010)

The above excerpts are taken from the lessons conducted in two different days with a Geography teacher, whom we call Nicole (or Mrs. Toh) in this paper – they provide a picture of the existing learning practices as we began the project. In the first excerpt, Nicole tried to open a dialogue with the students on why North Pole does not receive daylight for 24 hours, during particular time of the year. However, students closed the dialogue (up to this point) by answering that they already accepted this factual information from authoritative sources (i.e., video and textbook). In the second excerpt, Nicole invited two students to provide their explanations on how longitudes differ from latitudes. That had the potential to open up a critical discourse. However, one student expressed his reservation toward this practice as he thought that multiple explanations might be more confusing. These two excerpts demonstrate that students were comfortable with monological voices of authorities (i.e., teacher, textbook, and media) and were still dubious of a dialogic practice in their learning. Nonetheless, drawing from Bakhtinian thought, the language of the authoritative voice is “half someone else's” until it is incorporated with the hearer's own “intentions” and “accents” (Bakhtin, 1992, p. 294) – or, in Nicole's own words: until they are “internalized... and [not just] regurgitated... [from] the textbook”.

Preparing the grounds for dialogic competencies

“Voyage to the Age of the Dinosaurs” is a design-based research project that has grown over the last four years. It was implemented around a Secondary One (for students aged 11-12) Geography curriculum, covering topics from the Earth Sciences. We started with an informant design approach (Kim, Tan, & Kim, 2011a; Scaife, Rogers, Aldrich, & Davies, 1997), with which we conducted a series of five workshops over the years 2007–2009 to develop an educational game. During our third year, we worked closely with teachers from one of the collaborating schools. Aims of the curriculum design were: (a) to help learners understand and advance their own resources (i.e. experiences and ideas) as epistemic communities and (b) to engage learners in meaning-making and experiential learning activities that integrate a computer game and other tools developed through the informant design workshops.

With these aims, we set out principles for our design of curriculum to prepare a space where a dialogic discourse might naturally emerge. These principles are: (i) Engage students in group activities to develop epistemic communities; (ii) start with open-ended questions that could encourage the use of their preconceptions and their own approaches; (iii) engage them in activities that provide relevant experience using tools and hands-on activities; (iv) require them to produce group or individual artifacts, thus encouraging their ownership

of the process and product; (v) develop a sharing mechanism of the class, thus furthering their conversations; and (vi) engage them in consolidation and linking activities to understanding connections and gain confirmation about their ideas. In centering the interaction spaces as sites of learning, we hoped to “prepare the grounds” to allow an emergence of a dialogic space, signaled by indicators that characterize such a space.

According to Kubili’s (2005) application of Bakhtinian thoughts to an education context, a transformation towards a dialogic discourse is seen when the voice of the “textbook” gives way to “shared experience, shared knowledge and common evaluation of the [learning] situation” (pp. 513-514). In such a space at a micro-interaction level, words exchanged are polyvalent signs generated through attempts towards intersubjective sharing of meanings; and at a macro level of class participation, inquiry is “carnavalesque”, entered in a “spirit of enterprise”, with “freer and more active exchange of ideas” (pp. 529-530). Such an attempt in encouraging a dialogic discourse is consonant with some qualities of an effective education space, which Dhingra (2008), in his review paper on science education, argued should include “activities... for practice of skills and ... personal meaning making”, “validation of student funds of knowledge and authoring process”, and “exchange of students funds of knowledge” (p. 141). A dialogic discourse also resonates with sound pedagogic principles. While monologic discourse is important for “transmission of knowledge”, it provides no guarantee against misinterpretation and other communicative failures; it is a dialogic participation that encourages a “state of intersubjectivity”, where shared perspectives can clarify misunderstanding (Wells & Arauz, 2006, p. 393-395).

We believe that changing the classroom culture towards a dialogic practice would not happen with just a few lessons. As such in our implementation, instead of using such fundamentally different design principles in a few lessons, we decided to work alongside the teacher for the entire duration of the Secondary 1 geography curriculum, which covered half a year. Kress (2003) puts forward a theory of constant transformation of both resources and subjectivity, whereby learning is perceived as a change in resources resulting from active transformative engagement with an aspect of the world. The learner (the sign-maker) constantly transforms the set of resources and herself, at the same time building “funds of knowledge” (Moll, Amanti, Neff, & Gonzalez, 2001) in the classroom which bridge both school and out-of-school practices. Any preparation towards a dialogic discourse then needs to be patient with the sedimentation of actions, resource use, and shifting subjectivities which together constitute this transformation towards a dialogic space. The question for us to address in this paper then is how students develop conceptual agency within this emerging practice partly shaped by our design principles, thus initiating actions that recursively transform both resource use and learners’ roles and identities.

Our construct of “agency” aligns with a body of work that views agency as “emergence from activity systems” (Damşa, Kirschner, Andriessen, Erkens, & Sins, 2010; Gresalfi, Martin, Hand, & Greeno, 2007; Rainio, 2008). There is another significant body of literature (Adler, Rougle, Kaiser, & Caughlan, 2003; Greeno & van de Sande, 2007; Linn, 2006; Martin, 2004; Shanahan, 2009; Stefanou, Perencevich, DiCintio, & Turner, 2004) that locates agency primarily in a learner’s self-direction and autonomy, which is seen in a learner’s ownership of the learning process, using one’s own range of cognitive skills, and taking actions towards collective goals. However, Rainio (2008) argues that that agency cannot be “considered a stable property or an attitude of an individual” (p. 116). Damşa *et al* (2010) reasons that agency progressively emerges out of interactions between participants and their activities (p. 115). Gresalfi *et al* (2009) dismiss distinguishing between whether people “have” or “lack” agency, noting that both active and passive participations are equally agentive gestures (p. 53). What is important, for Gresalfi *et al* (2009), is not whether the students exercise agency, but how they do so in contexts that provide sets of affordances, with their implied values of what constitute competent participation.

Nonetheless, both bodies of literature provide some insight as to the kinds of agency students might take on which serve as useful indicators for us to locate agentive actions, for us to examine how these actions constitute the emergent classroom practice and is in turn supported by the latter. These indicators include acting with appropriate structures of dialogic argumentation (Andriessen, 2006); participating with “constructive listening” that allows conceptual changes within the learner (Greeno & van de Sande, 2007); using “process-related activities” that support, direct, and structure “knowledge-related actions” (Damşa *et al*, 2010, p. 149-152), playing identity roles that position each learner in distinct ways in the learning environment (Anderson & Zuiker, 2010), and managing one’s own disposition and attitude appropriate to a specific learning context (Rainio, 2008). This paper contributes to this conversation over agency by examining the relationships between some of these agentive actions and a dialogic space that is shaped by our design principles.

Understanding Agency in a Dialogic Community

The activities in all of Nicole’s class were recorded with video and audio recording devices. The classroom interactions were transcribed *verbatim*. We also wrote field diaries and collected various class artifacts, such as drawings the students produced, photographs of diagrams on the board and students’ journals – these allowed us to interrogate our observations. We selected two significant class lessons on the 21st of January and the 13th of

April, for discourse analysis (Gee, 2005) in this paper, based on how they represented a fair range of our design principles and how they instantiate the classroom practices at the beginning of our implementation and towards the end. In this section, we first describe what happened in each of the lessons, briefly account for changes between these two lessons, and then describe the emergent classroom discourse in the latter lesson.

In the January lesson, Nicole first reviewed the previous lesson on seasons and diurnal changes. Then, Nicole led a discussion of two ‘Thinking Questions’, the open-ended questions that the researchers prepared for classroom discussion. The questions for that day were: (i) “Why do people draw maps?” and (ii) “Why are there different types of maps?”. Finally, the students were given a task of drawing, in groups, a map showing the direction from one location in school to another. The class ended with the students evaluating each other’s work.

In the April lesson, Nicole reviewed the last lesson where they learned that atmospheric temperature decreases with increasing altitude. What they did not previously discuss was how that came to be – that gap served as the ‘Thinking Question’ for the first part of this class. The students speculated on some possible reasons. Nicole asked the students to draw schematic models to support their answers. One of the students presented his schematic drawing to the class, which in turn led to an intense discussion that, in the words of one student, was “more like a debate than a question and answer session”. With the discussions completed, Michele moved to the next topic on the hydrological cycle. Over a schematic diagram of the water cycle, the students explained the different elements in the cycle, filling in details of relations among the elements, which were absent in the schematic representation.

Learning, from in Unison to with Polyphonic voices

Between the lessons selected for our analysis, we see a transformation of a classroom practice. Table 1 below summarizes the changes that took place in the classroom practices between the two lessons. Column (A) identifies the design principles that provide our categories for comparison. These design principles had been earlier expanded upon in this paper, in exact order. Column (B) contains descriptions that qualify how the design principles were ‘translated’ in a lived practice in the January class. Column (C) contains descriptions that qualify how the design principles translated into practice in the April class.

Table 1: Characteristics of the classroom practice in January and in April

No.	(A) Design Principles	(B) Class on 21 Jan 2010	(C) Class on 13 April 2010
(1)	Working within Groups	(1B) Cooperatively/ Alone	(1C) Working with distributed responsibilities and conversing within/ beyond
(2)	Thinking Questions	(2B) Researcher-generated	(2C) Student generated
(3)	Activities	(3B) Researcher generated	(3C) Emerged in the classroom
(4)	Artifacts	(4B) Researcher generated	(4C) Ideas and diagrams emerged
(5)	Sharing Mechanism	(5B) Group leader/ Vocal member	(5C) More students volunteering
(6)	Linking Ideas	(6B) Predetermined by curriculum	(6C) Teacher-mediated/ Student mediated

Between the classes in January and April, we can identify a few changes. First, the nature of the students’ participation changed. Table 2 describes the changes in the students’ participation, taking into account only utterances from the students, substantial enough to describe a concept, offer an explanation, or extending an elaboration.

Table 2: Comparison of nature of class interaction

No	Types of Participation	21 January	13 April
(7)	Total number of substantial contributions from students	14	22
(8)	Total number of students who spoke substantially of their own accord	6	16
(9)	Number of utterances from most frequent speaker	7	3

The pattern of how students participated in class changed in the following ways: (i) more ideas were shared within the class discussions (7), more students volunteered to contribute (5 and 8) and vocal members had somewhat ‘restrained’ their active participation, allowing other members to contribute (5 and 9). Furthermore, the patterns of interactions within smaller groups also changed. For example, in the January activity in which students were tasked to draw a map, a student named James took most of the initiatives for the group work, analyzing the task, giving instructions, evaluating the process– even though he was not the nominated group leader. The rest of the members were simply cooperative with James (1B), who also happened to be the dominant speaker at the whole-class interactions (9). On the other hand, in April, students were asked

to choose a representative to speak for each group. James did not volunteer while one student in the group encouraged another member to represent them. Group members were shifting the procedural responsibilities among themselves (1C).

Second, Nicole exercised greater flexibility over how she used our lesson designs – this had the effect on allowing her to attend to the conceptual turns in the class discussions, and enacting a platform for the students to present their views. For example, in the January class, Nicole followed the lesson plans very closely down to the exact procedures of a group activity (3B) of drawing a map (4B). She also used the exact ‘Thinking Questions’ (2B) we provided. On the other hand, in the April lesson, Nicole began with her own inquiry thread that began with a gap from a previous discussion, asking “how temperature is affected by altitude”. Noting that the students needed first to consolidate the ideas on their own, she asked the students to draw schematic diagrams to illustrate their explanations (3C and 4C). A great amount of discussion ensued in which she allowed a broad range of answers. Thereafter, she helped the students to consolidate their own ‘Thinking Questions’, queries that arose from the class discussion (2C).

Third, the movement from using prescribed ‘Thinking Questions’ towards using open-ended questions that arose from the situated discussions encouraged students’ ownership over the dialogues, and that in turn, generated a huge amount of discussions. Consider the earlier discussion over one ‘Thinking Question’ in January:

Table 3: Extract of a class discussion over the Thinking Question – Why do people draw maps?

(10)	Nicole	Can I have a volunteer to share with us, what you have discussed with your (.) Er, group members. Why do people draw maps?
(11)	James	It's to prevent them from getting lost. ((The students start talking within the group without volunteering))
(12)	Nicole	Bryan. Hello, I asked for a volunteer to give the answer, why are you talking among your groups. That means you finish your discussion already. (.)Thank you. Now, we're all ears for you, Bryan.
(13)	Bryan	People draw map so that they can navigate easier around (.) the places that they are not very sure of.
(14)	Nicole	Thank you very much. Anyone wants to add to Bryan? He mention so that people can navigate ((The class is interrupted by an announcement)). Alright, now. Bryan mentioned something very interesting, it's about using maps for navigation. Can somebody explain what navigation means?
(15)	James	Moving around?
(16)	Daniel	Moving around.
(17)	Richard	To find their way.
(18)	James	To move around.
(19)	Alfie	Find their way.
(20)	Nicole	To find their way. Find their way where?

The contributions from the different students (11, 13, 15-19) converged around a simple idea of ‘a use of a map for navigational purposes’. The discussion over that ‘Thinking Question’ soon closed after the excerpt, with many students, answering in chorus “to their destination”. Nicole commented that was “interesting”, and moved to the next ‘Thinking Question’. Here, the students were acting on the learning process with “supportive” and “constructive” initiatives (Rainio, 2008, p. 123), responding to Nicole’s questions and probes; however, from a dialogical perspective such an ‘agency’ was counteractive towards broadening the dialogic space.

On the other hand, in the April lesson, the students’ contributions both diverged and converged in cycles, thus opening up the dialogic space. Table 4 is a simplified interaction map of the key ideas exchanged publicly in the April class. In that table, Nicole facilitated a discussion where cumulative contributions are shown by increasing indentation in the subsequent rows (e.g. 22-24) and divergent contributions are shown by a change in indentation direction (e.g. 41-44). Descriptions in italics either contextualize the events, or describe actions that were not part of the ‘flow’ of the class dialogue.

Table 4: Simple Interaction Map of a discussion over a Thinking Question on 13th April

Event	Class in dialogue
(21)	Nicole poses the Thinking Question: How is the temperature affected by altitude?
(22)	<i>Projection of an isotherm image, illustrating that the temperature of the atmosphere decreases with height</i>
(23)	Oliver: As you go higher, it gets colder.

(24)	Lijian: The air gets thinner
(25)	Unidentified: There is less carbon dioxide.
(26)	Nicole: It's not so much the composition of the air but more because of the air molecules... Closer to the ground the air is denser.
(27)	<i>Nicole asks the students to draw representations of their understanding. Nicole then asks Weiyang to share his diagram on the board.</i>
(28)	<i>Weiyang shows a class a diagram he draws, illustrating densely packed molecules at lower ground and loose molecules at higher ground. He labels the diagram: "Air is denser as altitude increases"</i>
(29)	<i>Nicole corrects Weiyang's label to read: "Air is denser as molecules are closer"</i>
(30)	<i>At a small group discussion, Erickson asks Nicole: "Dense air sinks not rise. How can it be dense air at the top?"</i>
(31)	<i>Group discussion and individual seatwork ends here. Nicole continues with the class lesson. Nicole: Erickson has an interesting question.</i>
(32)	Erickson: When air is denser, it traps more heat. Where air is less dense, it will trap less heat and hence it is colder.
(33)	Nicole: When hot air is closer to the ground, it gets heated. Won't the molecules be further apart?
(34)	Unidentified: Air will expand when it is heated,
(35)	Nicole: What do you understand about hot air when it is heated up?
(36)	Unidentified: When it rises, there is lesser air molecules.
(37)	<i>On the 31st March, the class discussed the movement of wind: How air flows from a high pressure to a low pressure.</i>
(38)	Richard: In a previous lesson on air pressure, we learned that hot air rises. So why is it hotter at the base of the mountain?
(39)	Nicole: If hot air rises, why is it colder up there?
(40)	Minghan: When hot air rises... the air molecules are more spaced out so it loses all heat. That's why it becomes cold air... cold air sinks...
(41)	Carlo: At higher ground, there is snow. At lower, there is rain. At higher ground, snow does not melt, that's why it is cold.
(42)	Sony: Is Carlo saying that there is hot air in the higher atmosphere to melt the snow?
(43)	Carlo: No. When snow passes through the atmosphere, it melts.
(44)	Sony: Why does it snow?
(45)	Thinking Question 1: Why does air become less dense at higher ground? [Ryan]
(46)	Thinking Question 2: Shouldn't the temperature be higher at higher ground since we are closer to the sun? [James]
(47)	Thinking Question 3: If hot air rises, why is it colder at higher altitude? [James]

Utterances are paraphrased for clarity

The interaction map illustrates how the process of linking ideas were no longer constrained by an adherence to the research design (6B), but mediated by Nicole (6C), as she arbitrated the exchanges of ideas. When the students took ownership of their discussion, we find them not only activating cognitive tools of engaged reasoning such as making claims and challenging them (24, 25, 30, 32), looking out for implications and inferences (36, 42); but we also find them doing more than that – they drew on knowledge from an earlier lesson (37-38) and even from another discipline (34, the student learned about the expansion of air in ‘General Sciences’). Furthermore, they even attempted to look at air convection from a larger system of weather phenomena (42, 44).

One very important emergence from such an ownership of the knowledge collaboration process is that some students took on Nicole’s role as a knowledge mediator (6C). At event (38), we find Richard assembling together two seemingly conflicting ideas – (i) that hot air rises, from an earlier class; and (ii) it is hotter at the base of the mountain, from the present discussion. At a next lesson, Richard also noted down two conflicting claims offered in the class discussion: (i) that air near the ground is “denser” because of “gravity” and (ii) that air molecules are “loose” near the ground because of the “expansion” due to “heat”. Gresalfi *et al* (2009) explained that participation structure and tasks partly “affords” learners' agency in a particular discourse (p. 52). Nicole’s modeling of a mediating role, and the divergent contributions from class members might have afforded Richard the resources to imitate this mediatory role. This role has an important place in collaborative learning because it allowed a temporary synthesis which, while never fully the ‘answer’, was a genuine gesture towards a quest for deep learning.

Polyphonic Voices, Symphonic Spaces, Authentic Sounds

A question then remains: How did the emergent practice take on the quality of a carnival-like exchange of ideas (Kubli, 2005), and afforded students like Richard to act with such agency towards dialogic discourse? We propose three important reasons that allowed students to exercise cognitive autonomy (Stefanou et al., 2004): (i) the role of the students’ own ‘inner persuasive voices’; (ii) Nicole’s positioning of students as competent participants in a dialogic space; (iii) ideas surfacing from students learning from each other’s ‘inner persuasive voices’; and (iv) the emergence of parallel dialogic spaces that ran alongside the whole-class discussions.

First, we will consider the interplay between the Nicole’s authoritative voice and the students’ ‘inner voices’ of their own knowledge artifacts. In the following extract from the April class, Nicole led a discussion on how the rainforest is an important source of water in the hydrological cycle. She shared a perspective that is constructed out of ‘textbook’ facts:

Nicole: The other way is that it goes into the sea or into the river. This leads to something very important. You did the chapter on tropical rainforest right? Did you, did you find out along the way that tropical rainforest is an important resource (.) of water?

Student: Yes.

Alfie: When you are running through a rainforest, you find that it is very humid.

Nicole: Exactly. When you were running into the rainforest, you find that it is very humid right?

Alfie’s contribution came from his own experience, a voice he “has found persuasive in [his] previous thinking” (Alvermann, 1998 p. 292). The embodied experience of finding the rainforest “humid” was used as a knowledge tool to understand Nicole’s authoritative claim, thus internalizing her voice with his own “intention” and “accents” (Bakhtin, 1992, p. 294). And when Nicole repeated Alfie’s contribution, her voice is enriched with not just the traces of Alfie’s experience, but also the isomorphic traces of the class members’ shared experience of how humidity felt to the individual students.

Second, Nicole used her authoritative voice to emphasize ‘every contributions count’, thus positioning the students as co-contributors. This led to an attitude change in the students that supported dialogic exchanges. In the April class, she commented that an idea Erickson made in his small group was “interesting” (33) and encouraged him to make his views public to the class, effectively using a gesture of positioning (Wagner, 2008., p. 145) to mark Erickson as a competent member of a discourse community. Even though she exercised her teacher’s monologic authority to constrain the direction of the discussion (31, 33, 35) and corrected misconceptions at times (29), these gestures are “retrospectively heteroglossic”, in that they open up more spaces for dialogues (Wagner, 2008. p. 155). In turn, Nicole’s positioning enacted a new space that favoured knowledge experimenting. Consider how Minghan supported Erickson’s contribution by saying to him – “even when it’s wrong, it’s interesting.” The emerging dialogic practice changed an older discourse of what counted as competent participation (Gresalfi et al., 2009) to one that is inclusive of all sorts of ‘interesting’ ideas. In this new dialogic space, Minghan could draw on his existing social role of a friend and “sidekick” to Erickson as a resource (Anderson & Zuiker, 2010) to initiate his own “process-related” action (Damşa et al., 2010) to direct Erickson towards a goal of enriching the dialogue from Erickson’s own voice.

Third, students in voicing their ‘inner persuasions’ that is articulated as ‘interesting’ contributions – regardless of whether they are ‘right’ or ‘wrong’ – allowed ideas to surface not from authority but from robust debates that enabled students to learn from sets of others’ ‘internally persuasive voices’. This is illustrated in the next extract in Table 5, which took place at event (32). Small group exchanges are italicized.

Table 5: A small group conversation around Erickson’s contribution

(48)	Erickson	When the air is denser it attracts more heat so at the sea level it will be hotter but then when but then when the air is less dense it attracts less heat so it will be cooler.
(49)	Weiyang	<i>Cos its denser it don't trap heat.</i>
(50)	Ching	<i>Why its denser?</i>
(51)	Nicole	I think Daniel don't understand. Anyone understand what Erickson is saying?
(52)	Ching	<i>Because the sun will reach the mountain first what.</i>
(53)	Weiyang	<i>Yea reach first but its //</i>
(54)	Ching	<i>I don't really get you//</i>
(55)	Weiyang	<i>When the air molecules are spaced out so it doesn't trap heat</i>

Erickson’s perspective (48) of air that is less dense “[attracting] less heat” clashed with Weiyang’s perspective (49) that it is less dense air that “trap[s] heat”. Nonetheless, they both share an implicit conceptual

schema (Greeno & van de Sande, 2007, p. 12) of ‘air as container of heat’ – except Erickson conceived of the less dense air molecules as having less ‘holding’ power on heat, as an object, between them; and Weiyang conceived of less dense air molecules with ‘spaces’ between them to hold more heat. Eventually, Weiyang accepted (55) Erickson’s perspective. Even though none of them were scientifically ‘correct’ in their explanations, the dialogue Erickson shared with his friends allowed him to activate the schema of ‘air as a container’ in language, and used the “affordances” of such a conceptual schema as a knowledge tool, to enact his own “conceptual growth” (Greeno & van de Sande, 2007, p. 12) and arrive at a tentative conclusion on why less dense air is cooler.

Finally, in the emergent practice the April class, there were smaller dialogic spaces that ran alongside the public exchanges, while students waited for the next student to speak, or even while the teacher was teaching. This allowed room for local exchanges and students could still continue to converse within their group, or even across their own group (1C). Prior to the next extract, the class were discussing why, given that hot air rises, the higher altitudes are colder. Richard suggested looking at snow but never had a chance to complete that idea. He turned to across to Erickson in another group (1C) –

Richard (to Erickson): You don’t understand. What I’m saying that I have a block of ice. I - I heat it up, become water right? Let’s say for example. A big chunk of snow among the clouds because of the higher atmosphere that’s why the hot air from the bottom rises up so it melts the snow and becomes rain.

Conclusions and Implications

We have described Nicole’s class as a learning community that transitioned from one established classroom practice that elevated monologic voices of authority to another practice that encouraged dialogic participation. In conclusion, we want to first frame our research findings within a larger context of how the lived dialogic space emerged together with transformed participations, both from the Nicole and her students. In our earlier paper (Wang, Kim, Lee, & Kim, 2011), we examined how Nicole’s role in the emerging epistemic community developed from that of a (i) teacher, to (ii) a facilitator, and then finally to (iii) a co-learner. Dhingra (2008) identified the teacher-roles of a “listener, interpreter, cultural broker, facilitator, and science knowledge resource person” as highly suitable to allow students to emerge as “co-participants in an inclusive and respectful community of practice” (p. 125). We would like to add that it is a shift from a teacher to a co-learner that allowed Nicole an access to a wider range of roles, accumulated in the transition, to support student dialogue.

At the same time, the students’ participation is characterized by an expanded use of the “funds of knowledge” (Moll, Amanti, Neff, & Gonzalez, 2001) that is counted legitimate in the emergent practice. Some of these funds of knowledge came explicitly from other lessons, other academic disciplines, and from their own experiences; others came as implicit conceptual schemas (Greeno & van de Sande, 2007) that can be used as knowledge tools. We find it useful to draw on Linn’s (2006) identification of four learning trajectories: (i) strategization of learning that maximizes learning efficiency by accepting definite authoritative voices in the discipline; (ii) conceptualization of a “broad range of ideas about a phenomenon”, (iii) contextualization of ideas within a specific learning context, without seeking other “connections” out of that context; and (iv) experimentation of new ideas and testing them out across different learning context. While Linn (2006) did not intend these trajectories to be sequenced developmentally, we find that – from the point of view of developing a dialogic space that is signaled by a profusion of authentic voices acting in collaboration – sequencing them in this order characterizes the development of the students’ participation, as students increasingly become more confident in drawing from a wider range of knowledge sources into the learning of Geography. The change in the students’ participation together with Nicole’s shifting position in the class worked in tandem to construct a different system of competence, which in turn reifies a dialogic participation (Gresalfi et al, 2009).

However, there is one very important aspect that this research into agency within a dialogic participatory space has not addressed. While we have focused on primarily on the spoken interactional discourse, we have not examined the roles of other components of the “activity system” (Gresalfi *et al*, 2009) of this dialogic site – components that are important in our design principles. Some of these components include the affordances of specific shared activities, including the manipulation of knowledge representations and the making of artifacts (Kim, Wang, Tan, Kim, Lee, & Pang, 2009); the actions that emerge from the development of sharing mechanisms, such as information uptakes and the types of evaluation offered that extend discussions (Wells & Arauz, 2006); and the high cognitive demands of ideas presented in linking and consolidating activities, which require a learner to bring together different inputs and performing further analysis or synthesis (Wells & Arauz, 2006). Further work needs to address this gap and is the future direction that we will undertake.

References

- Adler, M., Rougle, E., Kaiser, E., & Caughlan, S. (2003). Closing the gap between concept and practice: Toward more dialogic discussion in the language arts classroom. *Journal of Adolescent & Adult Literacy*, 47(4), 312-322.
- Anderson, K. T., & Zuiker, S. J. (2010). Performative identity as a resource for classroom participation: Scientific shane vs. Jimmy neutron. *Journal of Language, Identity & Education*, 9(5), 291-309.
- Andriessen, J. (2006). Arguing to learn. In R. K. Sawyer (Ed.), *The Cambridge handbook of the Learning Sciences*. (pp. 443-60). Cambridge University Press.
- Alvermann, D. E. (1998). Reconceptualizing the literacies in adolescents' lives. Mahwah, N.J.: L. Erlbaum Associates.
- Bakhtin, M. M. (1992). On dialogism and heteroglossia (the other(s)' word). In M. Holquist (Ed.), *The dialogic imagination : Four essays*. Austin: University of Texas Press.
- Damşa, C. I., Kirschner, P. A., Andriessen, J. E. B., Erkens, G., & Sins, P. H. M. (2010). Shared epistemic agency: An empirical study of an emergent construct. *Journal of the Learning Sciences*, 19(2), 143-186.
- Dhingra, K. (2008). Towards science educational spaces as dynamic and coauthored communities of practice. *Cultural Studies of Science Education*, 3(1), 123-144. doi:10.1007/s11422-007-9077-6
- Gee, J. P. (2005). *An Introduction to Discourse Analysis: Theory and Method*. London: Routledge.
- Greeno, J. G., & van de Sande, C. (2007). Perspectival understanding of conceptions and conceptual growth in interaction. *Educational Psychologist*, 42(1), 9-23.
- Gresalfi, M., Martin, T., Hand, V., & Greeno, J. (2009). Constructing competence: An analysis of student participation in the activity systems of mathematics classrooms. *Educational Studies in Mathematics*, 70(1), 49-70. doi:10.1007/s10649-008-9141-5
- Kim, B., Tan, L., & Kim, M. S. (2011). Why we should design educational games with learners: The affordances of informant design. *Proceedings of the 2011 International Conference on Computers in Education. Chiang Mai, Thailand: Asia-Pacific Society for Computers in Education*.
- Kim, B., Wang, X., Tan, L., Kim, M., Lee, J.W.Y., & Pang, A.L.H. (2009). Designing with Stakeholders for Learning Innovations: Voyage to the Age of Dinosaurs. Paper presented at the Annual Meeting of American Educational Research Association, San Diego.
- Kress, G. R. (2003). *Literacy in the new media age*. New York: Routledge.
- Kubli, F. (2005). Science teaching as a dialogue – Bakhtin, Vygotsky and some applications in the classroom. *Science and Education*, 14, 501-534. doi: 10.1007/s11191-004-8046-7
- Linn, M. C. (2006). The knowledge integration perspective on learning and instruction. In R. K. Sawyer (Ed.), *The Cambridge handbook of the Learning Sciences*. (pp. 243-64). Cambridge University Press.
- Martin, J. (2004). Self-Regulated learning, social cognitive theory, and agency. *Educational Psychologist*, 39(2), 135-145.
- Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (2001). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Practice*, 31(2), 132-141.
- Rainio, A. P. (2008). From resistance to involvement: Examining agency and control in a playworld activity. *Mind, Culture, and Activity*, 15(2), 115-140.
- Scaife, M., Rogers, Y., Aldrich, F., & Davies, M. (1997). Designing for or designing with? Informant design for interactive learning environments. In *Proceedings of the SIGCHI conference on human factors in computing systems*.
- Shanahan, M. -C. (2009). Identity in science learning: Exploring the attention given to agency and structure in studies of identity. *Studies in Science Education*, 45(1), 43-64.
- Stefanou, C. R., Perencevich, K. C., DiCintio, M., & Turner, J. C. (2004). Supporting autonomy in the classroom: Ways teachers encourage student decision making and ownership. *Educational Psychologist*, 39(2), 97-110.
- Wagner, D. (2008). "Just don't": The suppression and invitation of dialogue in the mathematics classroom. , 143-157.
- Wang, X., Kim, B., Lee, J.W.Y. & Kim, M.S. (2011). Developing an epistemic community in the classroom as teacher development. In S. Barton et al. (Eds.), *Proceedings of Global Learn Asia Pacific 2011* (pp. 1272-1281).
- Wells, A. H., & Arauz, R. M. (2006). Dialogue in the classroom. *The Journal of the Learning Sciences*, 15(3), 387-428. doi:10.1080/0023970660855708