Understanding Visitor Learning in a Natural History Museum : A Case of Dyadic Discourses

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Abstract: This study explores visitor learning in a natural history museum from the perspectives of situated learning. The purpose of this study is to understand how the visitors construct knowledge from museum experiences through dyadic discourses. The participants were two university students. They moved naturally through the exhibition with no predetermined path in a natural history museum in Korea. Data were collected in the form of audio-recorded dyadic discourses at and between exhibits and were transcribed. The transcription was coded using the conversation coding scheme, and categorized into specific learning types. The findings included (1) the characteristics of learning talks and (2) learning types created by dyadic discourses at and between exhibitions within learning contexts as museum learning experiences. Implications and future research related to visitor learning in informal learning settings were discussed based on the findings.

Key words: situated learning, informal learning, dyadic discourse, learning context, learning type

I. Introduction

Free-choice learning is the learning people do when they have the opportunity to control what to learn, when to learn, where to learn, and with whom to learn (Falk & Dierking, 2002). Young people and old people participate in free-choice learning; they do so through various media: television, books, radio, museum exhibition, through conversations with friends and family, and in ever-increasing numbers on the Internet. Free-choice science learning institutes are various including science centers, zoos, aquariums, and natural history museums.

Natural history museums are places where people see and enjoy the exhibits, and talk to and learn from each other. A growing number of educators have perceived and expected that informal institutional settings like natural history museums could play a more active role in science teaching and leaning (National Research Council, 1996). Whereas only a few years ago it could be fairly stated that it was unclear whether visitors to museums truly learned (Crane, 1994; Falk & Dierking, 1992, 1995), today the same could not be said (Falk & Storksdieck, 2005). There has been research examining individual student's cognitive and affective gains from experiences at museums (Melber & Abraham, 2002). It has been said that informal science learning contains the same fundamental elements that may be present in effective formal learning situations (e.g., cognitive challenges and social interaction) (Gerber, Cavallo, & Marek, 2001).

Free-choice learning in museums is strongly socio-culturally mediated. Research in out-of-school such as museums needs to consider social and cultural mediating factors including the role of conversations, social learning networks, cultural dimensions, and the use of groups as well as individuals (Rennie, Feher, Dierking, & Falk, 2003). Although looking at conversations is not new to classroom research, it is relatively new to informal learning research settings, which offer a richer context and more free-choice learning opportunities (Ash, 2003; Falk & Dierking, 2002). In this sense, visitor learning as complex experience of the exhibits cannot be understood in detail without understanding the dialogue which the visitors share with their family or friends through dynamic interactions. Therefore, there is a need to explore visitor learning through more naturalistic or open-ended study of visitor conversations, particularly

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those that happen "in real time" during the visit (Allen, 2002).

The purpose of this study is to understand how the visitors construct knowledge through their discourses. This study has two goals: to explore the characteristics of learning talks in a natural history museum, and to provide a rich description of the learning types created by dyadic discourses within intra- and inter -contexts.

Ⅱ. Theoretical Background

This study explores visitor learning in a natural history museum from the perspectives of situated learning. Situated learning includes the concept that learning happens in the relationship between individuals and larger environment, rather than dealing with the environments merely as factors influencing the behaviors and thinking processes of individual agents (Greeno, Collins, & Resnick, 1996). Furthermore, learning portrays the contextually driven dialogue as the process/product of the interactions between an individual's personal, sociocultural, and physical contexts over time (Falk & Storksdieck, 2005). It is suggested that learning is "situated" (Lave & Wenger, 1991); that is, it always take place in a specific context (cf. contextualism).

"Situated learning," proposed by Lave and Wenger (1991), is a theory about the nature of human knowledge, claiming that knowledge is dynamically constructed as we conceive of what is happening to us, talking and moving. From the perspective of situated learning, perception is considered to be more important than memorizing in learning, which explains why knowledge is activated in the specific situation (Young, 1993). People can make sense through perception and behaviors in the context. For understanding 'situatedness' conceptually, here, context needs to be distinguished from situation in situated learning, and then to obtain some theoretical background related to learning contexts and ZPDs.

1. Context vs. Situation

The terms situation and context are often used synonymously. However, to derive situatedness from the interaction of situation and context, it is necessary to dissociate these notions (Rothlfing, Rehm, & Goecke, 2003).

A situation consists of the spatiotemporal ordering of objects and agents alongside physically given constraints or characteristics like gravitational force or light intensity. In this study, we define situatedness as specific situations in which actions take place. In contrast to situation, context is a general construct that depends on various factors: socio-cultural (global) contexts such as language, or smaller (local) contexts such as seminar (Rothlfing *et al.,* 2003). Lave and Wenger (1991) and other situated cognitive educationalists saw the context as influencing not only what is learned, but as being an inherent part of what is learned (Botelho & Morais, 2006). A context supplies certain patterns of behavior and of analysis for situations an agent can be confronted with. A situation is thus embedded in a certain context (Lave & Wenger, 1991). In a given situation, there is not a single context, but rather a great number on different, possibly overlapping contexts.

Driver and Asoko (1994) emphasized the importance of context, arguing that learning science involves both personal and social processes. According to them, there is interplay between personal experience, language, and socialization in the process of learning science (Botelho & Morais, 2006). In informal learning research, context is considered as an important construct for understanding leaning as well. Learning is a uniquely personal, contextual experience, constructed from both internal (head and body) and external (physical world and sociocultural contacts) experience (Falk & Dierking, 2002). Falk & Dierking (2002) suggest the Contextual Model of Learning, meaning that meaningful learning is constructed by each person at the confluence of three streams—the contexts of the individual, the society and culture of the individual, and the physical environment in which the individual reside.

Internal and external experiences are corresponding to intracontext and intercontext respectively. When people interact with their environment or with one another they establish an intercontext (Rohlfing *et al.,* 2003). An intercontext is a social phenomenon that cannot be surveyed by a single agent, rather it hints at how an agent can interact appropriately in a

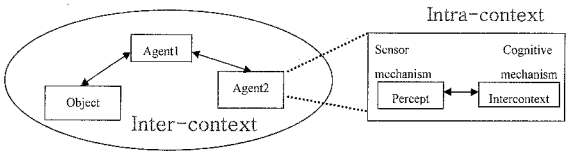

Fig. 1 *Inter- vs. Intra-context*

specific situation, i.e. the agent's options for acting. It suggests probable ways of how an agent acts and gives meaning to the situation. By its interactions in specific situations in a certain intercontext, an agent establishes its own intracontext, allowing it to make sense of the situations it encounters, i.e. to give meaning to them. The intracontext is a partial mapping from the intercontext. Fig. 1 shows inter- vs. intracontext. They influence each other. People interact with each other and with objects. These interactions establish the intercontext (left hand side in Fig. 1). Simultaneously, an individual agent builds up an intercontext, which in a partial mapping from the intercontext (right hand side in Fig. 1).

2. Learning contexts in a natural history museum and ZPDs

Learning, viewed as a process of concept formation, constitutes the other end of the scale of situated processes. Over time, an agent collects relevant information from specific situations and forms concepts. What is a relevant piece of information in a situation is influenced by the intercontext, since the same situation given in different intercontexts provides different relevant pieces of information for an agent. These concepts constitute the intracontext of the agent (Rohlfing *et al.*, 2003).

In this study, we define "learning contexts" as the interplay between inter- and intra-contexts for learning something. "Learning contexts" can be considered as an important construct to understand visitors' interactive learning experiences in informal learning settings like museums. Therefore, it can be said that learning contexts construct zones of proximal development between visitors. Ash (2003) viewed museum conversations as occurring within zones of proximal development (ZPDs) between individuals and between individuals and exhibits. The zone of proximal development can be defined as the "region of activity that learners can navigate with aid from a supporting

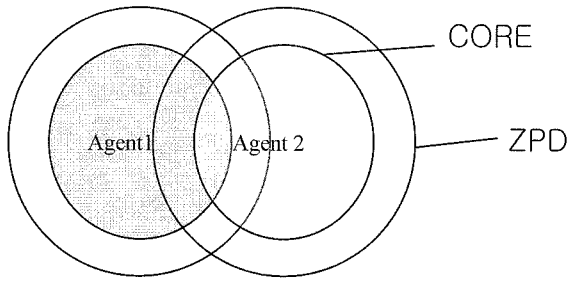

Fig. 2 *Vygotsky's Zone of Proximal Development (ZPD)*

context, including but not limited to people." (Ash, 2003; Vygotsky, 1987).

ZPDs can be represented as a band around the core of capabilities that the learner already has (Borthick, Jones, & Wakai, 2003). The core represents performance the learner can attain without assistance, and the zone represents what the learner can do with assistance. As Fig. 2 illustrates, the cores for a group of individuals overlap. However, the more important overlap is that of the one individual's core with another individual's ZPD. In the region of overlap, a more expert person can assist a less expert person (Borthick *et al.*, 2003).

Ⅲ. Methods

This study is to understand visitor learning in informal learning settings like museums. This study is about the case of dyadic discourses of two senior students; a male and a female. The participants were majoring in earth science education in university and more knowledgeable about the exhibits related to earth science than the other exhibits. Although they had never visited a natural history museum before, they were very interested in visiting science museums during the study. They were happy to join this study voluntarily. The dyadic discourses at and between exhibits represent the complexity of learning from museums. They moved naturally through the exhibition with no predetermined path for about two hours. Data were collected in the form of audio -recorded dyadic discourses at and between exhibits in a natural history museum in Korea.

1. Exhibition in a Natural History Museum

The natural history museum they visited in this study was established in 2004. The galleries in the

Table 1

Exhibition in the Natural History Museum

Floor	Exhibition
First floor: Dinosaur	Fossils, Chronology, Ecology, History, Age of Dinosaur, Excavation
Second floor: Earth & Life	Area 1: Universe formation ➢ The world of stars and nebulas ➢ Solar system exploration Area 2: Birth & evolution of the Earth ➢ History of the Earth ➢ The geologic structure of the earth ➢ Beautiful minerals and treasures Area 3-1: Life on Earth ➢ The origin of life on Earth ➢ The worlds of land and sea animals

natural history museum are: Dinosaur in the first floor; Earth & Life in the second floor; and Nature & Human in the third floor. Galleries in the first and second floor were involved in this study (see Table 1).

2. Data analysis

The discourse data were all transcribed for analysis. The data analysis consisted of two phases. In the first phase, the characteristics of utterances by the participants were identified. We used Allen (2002)'s coding scheme for analyzing the characteristics of utterances. The coding scheme has the 'emergent' components through her study, shaped by the nature of the conversations themselves. The scheme consisted of categories and subcategories of "learning -talk," utterances that we took as evidence of learning. Table 2 shows the hierarchical structure of the coding scheme, with 5 main categories and 16 subcategories of learning-talk.

Overall, we found our cording to be 82% reliable. In phase two, this initial analysis was used to explore particular learning types considering the contexts. First of all, any discourse can be parsed into different segment sizes based on each exhibit visit. Segments can vary from a short sentence to an entire discourse. In total, 40 segments are found. The segments can be analyzed and categorized into 'simple accretion' (25 cases), 'weak restructuring' (8 cases), and 'conceptual change potential' (3 cases). The remaining 4 cases were grouped into 'others'. As the results of this study, some representative cases of learning types were chosen and described. Table 3 gives an example of our analysis.

IV. Results & Discussion

Here we present the key results of the conversation analysis: (1) frequency of learning-talk categories and subcategories and (2) more detailed and complex learning types within learning contexts created by the conversation at and between exhibits.

Table 2

Coding scheme, with 5 categories and 16 subcategories of learning talk

Categories	Definition	Sub-categories
Perceptual	All kinds of talk that had to with visitors drawing attention to something in the sea of stimulus surrounding them	Identification Naming Feature Quotation
Conceptual	Cognitive interpretations of whatever was being attended to in the exhibit	Simple Complex Prediction Metacognition
Connecting	Any kind of talk that made explicit connections between something in the exhibition and some other knowledge or experience beyond it	Life-connection Knowledge-connection Inter-exhibit connection
Strategic	Explicit discussion of how to use exhibits	Use Metaperformance
Affective	All expressions of feeling	Pleasure Displeasure Intrigue / Surprise

Table 3

An example of our analysis phase two: a case of simple accretion

Learning-talks	Categories	Sub-categories	Context
A: I heard meteorites are expensive. (here they are)	Affective	Surprise	Exhibit: various meteorites Intra-: A and B are surprised at seeing the meteorite in real. Inter-: A and B talk to each other about their perceptual, affective, conceptual inferences.
B: Oh~ I like meteorites.	Affective	Pleasure	
A: How can we find this ever? And how can we know whether it is real meteorite or not?	Conceptual	Simple inference	
B: I think the meteoric iron can be found.	Conceptual	Simple inference	
A: There are nickel meteorites, too.	Perceptual	Identification	
B: I heard nickel is not easily found.	Connecting	Knowledge -connection	
A: Wow. This meteorite in here, is really big. Isn't this an imitation?	Affective	Surprise	
B: Is it right? Might this an imitation?	Affective	Surprise	
A: Tektite. White. This is pretty. Whit Green Tektite.	Perceptual, Affective	Naming, Pleasure	
B: Right. This looks just like quartz.	Conceptual	Simple inference	

1. Categories and subcategories of learning-talks

Fig. 3 shows the frequencies of the five major categories of learning-talk: perceptual, affective, conceptual, connecting, and strategic. The frequency of each category of talk has been calculated as a percentage of the total number of the participants' utterances (445). The common categories of talk are perceptual (172, 38%), conceptual (106, 24%), and affective (87, 20%) in descending order. Noteworthy is the lower frequency of connecting talk (66, 15%) and strategic (14, 3%). Connecting talk includes connections among exhibit elements, connections to previous knowledge, and personal stories or associations. These kinds of connections are often regarded as a powerful and ubiquitous means of learning in informal settings, so it is interesting that the category was much less frequent than the "Big 3" (perceptual, conceptual, affective).

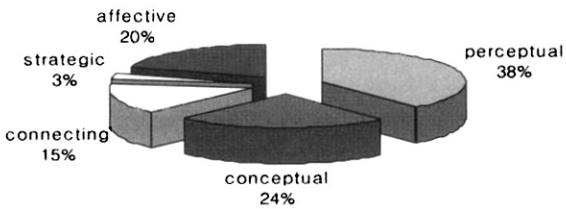

Fig. 3 *Frequencies of different categories of learning -talk*

Fig. 4 shows the frequencies of the 16 subcategories of learning-talk. The Fig shows a detailed analysis of the different kinds of utterances that contribute to the larger categories of conversation. The most common subcategories of learning talk were: feature (76), complex inferencing (57), intrigue / surprise (44), life-connection (43), identification (40), naming (37), and simple inferencing (36). In contrast, inter-exhibit connection (0), metaperformance (3), metacognition (4), prediction (9), and use (11) were less common.

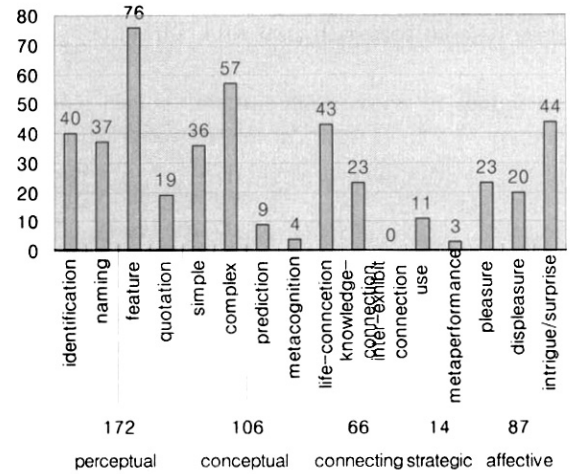

Fig. 4 *Number of different subcategories of learning-talk*

2. Learning types

As described in the previous section, there were mainly perceptive, conceptual, and affective aspects of learning talks in the participants' conversations. To understand visitors' learning in depth, we explored learning types weaved from their conversational learning contexts. As the results, we present three particular learning types in the learning contexts: (1) simple accretion (i.e., information addition or preservation), (2) weak restructuring (i.e., conceptual capture or conceptual elaboration) (Herrison, Grayson, Treagust, 1999), and (3) conceptual change potential. In this study, we could not discover any evidence of 'strong restructuring' (i.e., conceptual exchange or radical restructuring) in the dyadic conversations. Instead, we present 'conceptual change potential', meaning it involves the potential for conceptual change at weak or strong levels anytime and anywhere in the future.

Learning Type 1: Simple accretion

Learning Type 1 was found in a large part of the participants' conversations (25 cases). These conversations included many perceptual characteristics such as identification, naming, feature and conceptual characteristics such as simple inference with simple conception. Although their conversations included also many knowledge-connection things, it seemed that they constrained to mention something about the features of exhibits and their experiences. In addition, the participants showed a lot of emotional responses like dis/pleasure or surprise. In other words, during the conversations in watching the exhibits, they mostly preserved their own conceptions or adding new information.

Case 1 and Case 2 are the representative examples of this learning type. As can be seen in Case 1, A and B showed emotional responses in front of the exhibit 'meteorites' at first. Then, A asked a question and B presented his conjecture without any reasoning about A's question. Their question and answer were very simple and of affective and perceptive levels. While they continued to watch various objects in the exhibition, they just made emotional responses to them. Therefore, it can be said that A and B could get more information from the exhibition as they matched the names of objects and perceived their special features sensually.

Case 1: Meteorite

A: These are··· I heard meteorites are expensive.
B: Oh~ I like meteorites.
A: How can we find this ever? And how can we know whether it is real meteorite or not?
B: I think the meteoric iron can be found.
A: There are nickel meteorites, too.
B: I heard nickel is not easily found.
A: Wow. This meteorite in here, is really big. Isn't this an imitation?
B: Is it right? Might this an imitation?
A: Tektite. White. This is pretty. Whit Green Tektite.
B: Right. This looks just like quartz.

Case 2 showed a dialogue between the participants about gastropoda exhibit. A was interested in exhibition and asked, "What is gastropoda?" Then, B emphasized that they learned it in high school, but she did not explain it. Regarding this conversation, A showed an interest in the exhibit of cannibalism clam and talked about daily life and living things in another country. This dialogue can be analyzed as a type of information acquisition which each of them already knew or did not know. Case 2 seems to be same as Case 1.

Case 2: Diverse animals in the sea

A: Gastropoda. What is gastropoda?
B: Gastropoda. You should learn biology again. We all had to memorize these things when we were high school in biology 2 class.
A: It says cannibal shellfish. When human feet are accidentally put inside this shellfish, they never can be pulled out. You see? This is very scary.
B: Isn't this the reason that people do scuba diving? It will be very fun if you actually see these things.
A: My teacher said there are lots of crabs in Canada.
B: I heard that too. But people caught too many so they are now on the endangered species.
A: Really?

From Case 1 and Case 2, it can be summarized that each participant received some information through seeing the exhibits and reading the explanations regarding these exhibits. They simply asked questions: they did not try to formulate explanations. Therefore, they could not continue to discuss the

exhibits in-depth, and did not have an opportunity to explain conceptual change at weak or strong levels. These cases showed us how the 'simple accretion' learning type added new information to their existing information.

Learning Type 2: Weak restructuring

Although Learning Type 2 was not greatly found in the student conversations (8 cases), it could be interpreted as being a very meaningful learning level. Based on the categories and subcategories of learning -talk, this learning type had mainly perceptual and conceptual characteristics.

We present Case 3 and Case 4 as representatives of this learning type. Case 3 included the conversation held by the participants at the exhibit of 'unconformity and nonconformity'. They had the good learning experience of differentiating unconformity from nonconformity in talking about the exhibit. Case 3 showed the process of conceptual elaboration through: A's identification, A's knowledge connection, and A & B's quotation from the panel, and sharing meaning between them.

Case 3: Unconformity and nonconformity

A: Ah~ Nonconformity is this.
B: What is nonconformity?
A: I thought nonconformity has just slopes and unconformity has more complex shapes..
B: So, what is nonconformity?
A: It is written right here. Just, igneous rocks or metamorphic rocks should have been under there.
B: Ah~. So, if there are just like these, that means unconformity. And if there are igneous or metamorphic rocks under, that means nonconformity. Right?
A: Igneous rocks or metamorphic rocks should be under there.
B: Mm. Then what is the difference between unconformity and nonconformity? Isn't it one kind of unconformity?
A: I think it is one kind of unconformity. One kid asked about this before, but I couldn't answer it.
B: OK. OK.

Case 4 included the conversation held by the participants at the exhibit of 'calcites'. The participants observed and perceived the characteristics of diverse calcites, and talked to each other about the nature of calcites. They discovered that calcites had different shapes and colors. As a result, they wondered what the factor of determination of calcites was. At that point, B initiated the question, "What is the real crystal?" After A read the text on the panel to get a clue, the participants could reach to understand that calcites were composed of calcium carbonate with various crystals. Therefore, they could understand the definition and the characteristics of calcites, and try to share the meanings of them. This finding indicates that they elaborated their conceptions in discussing calcites.

Case 4: Calcite

A: This calcite became moldy a lot. Or not. There is something on the calcite. What are those things which stick in clusters around this?
B: Isn't it powder?
A: Wow. This is the perfect calcite. I can see the perfect crystal in this. This is the real crystal.
B: Definitely big and good.
A: This calcite here and that calcite are so different that I would never know without the panel.
B: Right.
A: This and this, each have different colors.
B: (read) The most similar following the arrangement. This looks like a rock.
A: Isn't that small thing attached over there the calcite?
B: The colored one? No. It shouldn't have color.
A: Is that right? Hey, this one up here is also calcite. That is calcite, too. That, too.
B: Right.
A: These all are calcites. All look different, though.
B: Then what is the real crystal, Buddy?
A: Ah~ Right here. (read) They have beautiful crystals, and most various types among minerals. I guess the way which decides the calcite is not crystals but components. If the components are same, that can be calcite.
B: Then slant hexahedron is not the..
A: Right. But that fact is written in here. They belong to the hexagonal system.
B: Calcites over there, too. There are lots of calcites in here.

From Case 3 and Case 4, it can be summarized that the participants were stimulated to think about 'calcites' from the exhibits of calcites with various colors and sizes and they reached to elaborate their conceptions through talking to each other about that. These cases showed us the learning type named 'weak restructuring', learning things the participants did not know by making connections to what they

already know (Hewson & Hewson, 1992). In these conversations of Case 3 and Case 4, it seemed that inter-contexts between participants, and between participants and exhibits were interplayed very well.

Learning Type 3: Conceptual change potential

We call Learning Type 3 'conceptual change potential' because it did not show any evidence of conceptual change but had the potential for it at weak or strong levels in the future (3 cases). On the basis of the categories and subcategories of learning-talk, this learning type had mainly conceptual characteristics including conceptual inferences.

In this case, although their conversation involved problem posing and the participant's own reasoning for solving the problem, they did not reach any conclusion or interpretation about that. In this conversation, the question remained unsolved. Case 5 was a representative of this learning type.

When the participants read the panel with the exhibit (picture and model of sea animals in the period of the ice age), B posed the question, "How come these exterminated which they lived under the sea?" Then, A answered "meteorite fall" grounded on the explanation on the panel and B had his argumentation against A's idea. Although B had his own reasoning of his idea, they moved on another exhibit without reaching any conclusions or getting any warrants supporting his ideas.

In this conversation, B posed a question and gave his own reasoning as an attempt to solve it, but did not obtain any information and reasoning from A and the exhibit. The exhibit contributed to stimulate him to think about a question, but did not provide him with data or grounds to his reasoning for solving it. And his peer, A also did not help him solve the problem. This behavior could be interpreted as indicating that although this learning type did not come under weak or strong restructuring, it had potential for conceptual change at any level in the future.

Case 5: Dinosaurs

A: I have a question. I understand things living on the land can be exterminated, but how come these were exterminated when they lived in the sea?
B: This panel says meteorites fell all over the Earth.
A: If meteorites fall, outside circumstances like air composition or temperature can be changed, but the circumstances in the sea wouldn't change.
B: There is no air in the sea, then how can be air existed in there?
A: The reason they were exterminated was not the lack of air. It was because of temperature changes. If air had not existed, there would be no organics nowadays. Only the reptiles died because they couldn't adjust to the temperatures because reptiles are cold blooded animals. I think reptiles living outside the sea would be dead, but why did the reptiles under the sea die?
B: ···

3. Learning contexts & ZPDs

The interplay between inter- and intra-context, i.e. the strong structural coupling of an agent with its physical and social environment is embedded in a situated learning. We call this complex context affecting learning "learning contexts," providing an agent's ZPDs.

In Learning Type 1, the participants perceived the characteristics of the exhibits and talked to each other what they already knew and what they came to know at the exhibits. There was greater interplay of inter-contexts between each participant and the exhibits than between the participants. This finding indicates that inter-contexts between the participants would not be well revitalized. Therefore, we cannot state that their ZPDs were activated in this learning type.

In Learning Type 2, the participants elaborated their conceptions of 'calcites' or 'unconformity and nonconformity'. They talked to each other about their conceptions in observing and perceiving the exhibits and the explanations on the panels. There was a strong interplay of inter-contexts between each participant and the exhibits, and between the participants much rather than in Learning Type 1. In Learning Type 2, the common ZPDs for the participants overlap (colored area in Fig. 5) and activate to restructuring their conceptions at a weak level.

In Learning Type 3, one participant (Agent 1) posed a question and did not solve the problem. The other participant (Agent 2) did not mention his question. Although some interplay of inter-contexts existed between each participant and the exhibit, none existed between the participants. Therefore, we can state that the question one participant posed was still remained in his mind and could be solved in the

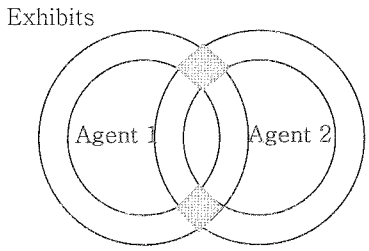

Fig. 5 *Learning contexts and ZPDs in weak restructuring*

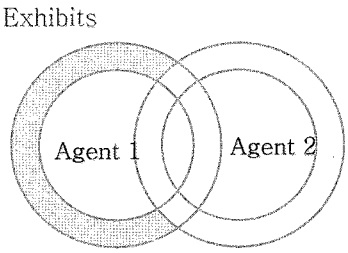

Fig. 6 *Learning contexts and ZPDs in conceptual change potential*

future. It seems that the ZPDs of Agent 1 were not in common with those of the other agent, but remained a potential area for the Agent 1 to learn from in the future (as shown by the colored area in Fig. 6).

V. Conclusions

The findings presented in this paper show visitors' learning talks, learning types, and ZPDs within learning contexts in a natural history museum. The study showed that the participants' talks in the museum included multiple instances of perceptual, conceptual, and affective responses to the exhibits. While museums may have unusual strengths in facilitating affective or sensory learning, it is also important to recognize that visitors engage frequently in cognitive learning-talk during their exhibition visits (Allen, 2002). These perceptual, conceptual, affective, or the other responses (i.e., connecting and strategic) shared continuity with each other in creating certain learning types.

As a result, with the three kinds of learning types, we see that a relationship exists between these learning types and visitors' learning-talks. Moreover, it seemed that when the visitors' learning-talks created kinds of conceptual change, these changes were related to their previous knowledge or past unsolved problems with regards to the contents of the exhibition. Although it is unclear at this point if this argument can be expanded into a generalization, our findings showed that the simple accretion learning type consisted mainly of perceptual and affective aspects, whereas the weak restructuring learning type consisted mainly of perceptual and conceptual aspects. The conceptual change potential learning type consisted mainly of conceptual aspects, including complex inferences.

Another important point to note here is that visitors' learning would be affected by the interplay of: intra-context within each participant, and inter -contexts between the participants and between participants and the exhibits. In particular, this study illustrated that inter-contexts between the participants and between the participants and the exhibits were facilitated in their conversations. When they interacted with each other within inter-contexts, the participants' ZPDs were facilitated. When questions arose in the participants' minds, they could explore these questions with each other. Sometimes the participants could solve queries through conversations or through the help of panels, and sometimes they could not. It can be expected that the participants' ZPDs involving unsolved problems possess the potential of kinds of conceptual change within inter- or intra-contexts in the future. It is of interest here to note that museum experiences would be supportive or useful for learning school science. Therefore, students' ZPDs facilitated in museums should be considered and be the starting points for expanding their previous knowledge when their visits aimed to learn something related to school science.

This study has implications for informal education. This trace of the visitors' conversations provides important insights into informal learning in museums. This research will help museum educators and staff members to understand visitors' learning experiences in their museums, and then to construct various programs considering visitors' conversations at the exhibits. This research also will help for science educators deeply to understand informal science learning.

Although this research provides some information

on visitors' learning in a natural history museum, the findings cannot consider various contextual aspects affecting these visitors' museum experiences. For further research, we suggest that there is a need to study how visitors' learning-talks and learning types in museums are related to various other aspects including exhibit types or dyads (e.g., peers, family, student-teacher).

Reference

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