Exploring the Nature of Interactions in Science Classroom

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ARTICLE INFO	ABSTRACT
	This article explores the nature of interactions in science classroom in order to enhance learning. Research in this area has attracted huge attention from many researchers evidenced in growing publications of this topic. Researchers have studied the topic from different angles and have covered different research avenues from structural patterns of interaction, joint construction of meaning, to the exercise of power relation, and to social identity construction. The researchers have examined how patterns of language use affect learning, how these patterns affect the equality, or inequality, of students' learning opportunites, and how these patterns foster certain communicative competences. As the current focus may be too general for particular classroom, future research may need to focus on one aspect of the classroom interactions for more in depth analysis.

I. Introduction

Research in science classroom interaction has attracted huge attention from many researchers evidenced in growing publications of this topic. Bruna and Gomez (2009), for example, have edited a book which is specially contributed to the study of talking and writing science in multicultural classrooms. To give an illustration, Van Dam & Bannink (2006) have explored the dynamic discourse approach to classroom research, focusing on the analysis of structural patterns of interaction used in different classroom settings in the Netherlands where English is taught as a second language. Another illustration, Lee (2008) examined teachers' use of yes-no questions not only to elicit a response, but also to build resources for the students through recognition of appropriate responses. Cazden (2001) identified three questions that are prominent in the study of classroom interaction, namely how patterns of language use affect knowledge and learning, how these patterns affect the equality, or inequality, of students' educational opportunites, and what communicative competence these patterns foster.

II. The Nature of Science Classroom Interactions

Researchers have studied science classroom interaction from different perspectives and have covered different research avenues from structural patterns of interaction, joint construction of meaning, to the exercise of power relation, and to social identity construction.

III. Joint Construction of Meaning

One of the functions of classroom interaction deals with the joint construction of meaning out the content of the lesson and the processes that take place. In this process of co-construction of meaning teacher and student work together in collaborative manners using different techniques. For example, some teachers use definitions of their own and the definitions of their students to construct meaning. This technique of constructing meaning has appeared to be effective (Temmerman, 2009). Temmerman studied ccomunicative aspects of definitions in classroom interaction, focusing on how the meaning of word definitions was structurally introduced within the context of a primary classroom. She identified three structured definition categories as focus of analysis: definitions given by the teacher, by individual students, and by collaborative constructions between students and teacher. Her finding shows that each of the structured categories served a specific function in the understanding

and appropriation of the meaning. The definitions given by the teacher helps students understand the meaning and to make associations between the meaning and the concept. The definition given by the teacher would often resemble definitions found in a dictionary. On the other hand, the definitions given by the students reflects a collaborative exchange of meaning negotiation that exhibits students' knowledge and comprehension of the word's meaning.

Another technique to construct meaning is through mediation through teacher-student talk. Gibbons (2003) investigated how teacher-student talk in a content-based (science) classroom contributes to learners' language development. The mediation process through teacher-student talk found effective to develop both conceptual knowledge and target language skills – especially that of academic discourse. Gibson asserted that through this process of mediation, students' contributions to the discourse are progressively transformed across a mode continuum into the specialist discourse of the school curriculum. Central to the linguistic development is the interaction between the students and the teachers both being "active participants in the co- construction of language and curriculum knowledge" (p. 247).

Teacher can also help student construct meaning by connecting the topic with students' previous knowledge. Thompson (2008) asserts that children are more eager to talk when class discussion is "taught to build on a previous knowledge and pupils' own experiences" (p. 246). Thompson states further that there is an agreement regarding the belief that lessons developed around out of the school context produce longer spoken contributions. Therefore, he argues for teachers to ground classroom speech genres in the dialogic function of text, so that each voice can take other utterances as thinking tools.

Constructing meaning is also made possible by means of the use of other languages in the local context. Evnistkaya & Morton (2011) found the construction of knowledge was facilitated by the use of not only the language of instruction but also other languages available in the local context. Brown & Spang (2008) found the same practices emerged in the classroom when they observed a teacher teaching a science literacy lesson for minority students. Teacher used this mode of classroom language, i.e. teacher's hybrid method of language involving the use of vernacular and scientific language in her explaining science concepts for a particular reason, i.e., to help students negotiate the meaning. This technique has been widely practiced in lower grades elementary schools in Indonesia (Idris, 2016). In the context of Indonesia, instructional content is basically delivered through *Bahasa Indonesia,* and whenever necessary teacher could possibly use a *bahasa daerah* (vernacular language) dominantly spoken in the teacher's class. It may be Bimanese, Sasak, or Balinese depending on which language majority of students and teacher speak, which is closely tied to where the school is located across town or island.

Drawing on the afore-mentioned studies, we can see different strategies by which teacher and students co-construct the meaning out of the curricular content taught. The application of such strategies vary across context, suggesting that socio-cultural context around the instruction influences the way classroom process is structured and that the importance of incorporating students' linguistic repertoire into science discourse. Further incorporation of students' varying repertoires may lead a to pedagogical transformation as suggested by Gardner (2008). According to Gardner pedagogical transformation works are possibly realized in discourse threads weaved through the teacher-student interaction for the sake of student success. Two of five key discourse threads are related to covering the curriculum and shifting the locus of experience, each of which embodies different pedagogical principles.

IV. Pattern of Knowledge or Epistemology

Other avenue of research on classroom interaction deals with the interplay between students' epistemology, which is what students know or may want to know and type of interaction that may take place in classroom. Lidar, Lundqvist, & Östman (2006) analyzed the practical epistemology used by students and the epistemological moves delivered by teachers in conversations with students to see how teaching activities interplay with the the way in which students learn and with the content they learn. These researchers focused their investigation particularly on the experiences of students and their encounters with the teacher. They found that a study of teaching and learning activities provides insights into which role epistemology plays in the process of students' meaning making, in teaching, and in the interplay between these activities.

Good examples of this interplay can be seen from studies by Mackey, Kanganas, & Mackey (2007), Mortensen (2009), and Walton (2000), to mention some of them. Mackey and colleages (2007), for example, examined patterns of task-based conversational interactions while the researchers manipulated the students' familiarity with the procedure and content of the tasks. The results of the study showed that the unfamiliar tasks resulted in more clarification requests and confirmation checks as well as more corrective feedback on nontargetlike utterances to each other. Conversely, the familiar tasks enabled more opportunities to use feedback. Finally, the "learners engaged in tasks that were familiar in both content and procedure showed more actual use of feedback" (p. 285).

Likewise, Mortensen (2009) argues that framing the talk, as well as the content of the talk itself, is a social practice that forms a relationship between students engaged in classroom discourse; this relationship, in turn, establishes recipiency and the turn-taking processes. Such recipiency and turn-taking process are made possible for there is usually gap of information between talkers toward the content of talk, and thus there is always process of asking and confirming.

In relation to this, Walton (2000) argued that what children "know or believe about the nature of the mind and of knowing" are linked to what they do in social interactions (p. 134). Walton based his argument on data from transcribed conflict episodes in ten kindergartens through fourth grade public school classrooms, specifically interactions with verbs of knowing. It was reported that expressions of certainty or uncertainty using the verbs of knowing regulated conversation, and the children and teachers were concerned with accuracy and perception.

To reiterate from what has been discussed in this section, we are informed that learners' epistemology affects the way in which interaction is framed. Once an element in the epistemology detoured or removed the subsequent moves are likely to happen in the whole discourse. In conjunction with this, Nystrand, Wu, … & Long, D (2003) investigated quantitatively the effects of discourse moves on subsequent interactions and the structure of classroom discourse. However, these researchers focused more on how discourse moves from external, that is how participants' social surroundings influenced the nature of the discourse. All these findings emphasize the importance of understanding teacher-student interactions as co-constructors of knowledge, as lower-tracked students discursively interacted differently than higher-tracked students.

V. Exercising Power

Types of interaction in classroom may show power relation between speakers, one may be more powerful while the others less powerful; one being superior, another inferior. Candela (1998) examined how the teacher uses discourse in order to exert power over the students. According to the results, these power differentials hinders the ability of students whose cultural capital is not compatible with the teacher's to appropriate knowledge through the use of that particular discourse in the classroom. All students might receive from teacher who likes exerting power is the feeling of fear and anxiety. Matsumoto (2010) examined how such dynamics affect the way students attempt to improve their ability to speak English. Matsumoto asserts that fear and anxiety under the authoritative teachers may keep them from learning.

Another form of power exert is silencing by teacher in classroom. Leander (2002) looked at silencing as an interaction that socially positions participants as privileged or suppressed. Leander looked at the role that silence plays in the power structures between the discourse of a group of White female students, and the other students in the classroom. The results indicate that silence is a socially produced form of discourse that involves the development of power relations and hegemony.

Likewise, Liu and Hong (2009) looked at another example of power relation between teachers and students. Liu and Hong explored what choices teachers make of directives for what regulatory purposes and how it the positions students in the tantamount with the specific sociocultural context in Singapore. They attempted to examine the regulative role that teacher directives play in the regulative discourse where the relations of power between teachers and students are enacted. Strong regulative discourse based on the use of authoritative directives affords the students little opportunity to play with reciprocal interactions and to assume different roles.

Other manifestation of power relation hapens through positioning and positioned, especially between gender, as a result of teacher assuming too much different roles from students. Menard-Warwick (2007) analyzed two events of gendered positioning that took place during a unit on

employment in an ESL program for adults in California. The author claims that it is the tensions inherent in the teacher's assumptions about her students' identities that led to the events of positioning. The author gave an example that in an event a learner contests being positioned as primarily a homemaker; in the other, a more-advanced learner appropriates this positioning to her own ends in the classroom. The author concludes that events of language learning and social positioning often occur simultaneously in the L2 classroom.

To avoid teacher from being too authoritative or exerting too much power in classroom Matsumoto (2010) suggests that group dynamics is implemented. Matsumoto also points out that students will probably acquire more of their L2 evidence in their improved ability to speak when the have more opportunity to speak in the classroom through group dynamics. The author wrote that working with group helps to overcome students problems of shyness, nervousness and lack of confidence when they try to speak English. Likewise, recording or taping students speaking allows for the students to learn from their own introspection and other students' comments more effectively. In addition, finding from Leander's (2002) study shows that students are able to shift these power differentials by reverting the IRE structure embedded in the teacher's discursive practice through local interactions in order to appropriate knowledge and establish themselves as members of that particular community of practice.

However, authoritative discourse cannot be removed completely from classroom. All teacher can do is to balance the use of authoritative and dialogic discourse. Scott, Mortimer, & Aguiar (2006) examined the movement between authoritative and dialogic discourse and shifts between communicative approaches as an integral part of teaching that supported meaningful learning of scientific knowledge despite the fact that there was a necessary tension between authoritative and dialogic discourse. This tension happens as dialogic exchanges were followed by authoritative interventions with the purpose of developing the standardized scientific view on the part of students, and the introduction of new ideas through authoritative discourse was then followed by the opportunity for dialogic interactions to follow up those ideas. The exchange or combination of communicative approach and authoritative interversions could be a seed for dialogicity. Dialogicity is an ideal condition for role relations in the classroom. As Boyd and Markarian (2011) assert, in dialogic classroom we can witness that "the discussion was collective, reciprocal and supportive" (p. 529" and "students can challenge and be challenged and this is perceived as evidence of intimacy- of trust and solidarity" (p. 530).

These articles provided insights into the importance of understanding power relation in classroom and of the importance of group working to reduce the tensions between authoritative discourse and dialogic discourse and reduce the chance for teacher to exert power in classroom. But, we need to keep in mind that authoritative discourse is an integral part of classroom discourse; its presence is needed to create an aquilibrium; therefore, it cannot be totally absent from classroom.

VI. Conclusion

Research in science classroom interaction has attracted huge attention from many researchers evidenced in growing publications of this topic. It has also explored different avenues from types of interaction that lead to meaning-making processes, to teacher questions, and identity construction. This is in line with Cazden (2001) that the study of classroom interaction mainly focus on how patterns of language use affect learning, how these patterns affect the equality, or inequality, of students' learning opportunites, and how these patterns foster certain communicative competences. However, due to limited resources I have, there are still a lot of thing that should have been covered in this paper. Also, what has been covered in this paper is still too general; therefore, future research should focus on one aspect of the classroom interaction to look into more in depth.

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