INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

UMI®
WHY EDUCATIONAL REFORM PERSISTS:
A STUDY ON ROUTINE GROUNDS OF
CLASSROOM LESSONS IN THE KOREAN CASE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By
Minho Shon, M.A.

The Ohio State University
2001

Dissertation Committee:
Professor Douglas Macbeth, Adviser
Professor Suzanne Darnar
Professor Michael Beeth

Approved by
Advisor
Educational Policy & Leadership
ABSTRACT

The transformation of classroom instruction, from whatever is "conventional" at a given historical time, to what is by the consensus of a larger research and professional community a "better way of teaching," has been the identifying program of instructional research, and classroom reform more generally, for the last hundred years. This field study of Korean classroom contexts, examines a contemporary iteration of the impulse to instructional reform, in a national movement towards "Open Education." It does so with an interest in the organizational problematics that may be common to every instructional reform movement, as they are expressed in the particulars of current reforms in Korea. It then pursues a case study in instructional reform, in the context of Korean science education at the elementary grade levels.

The study initiates the examination of the contemporary discourse concerning "authentic" pedagogy and, as its central discourse, constructivism. A constructivist understanding of how students understand and act in their world, in particular, along with achievements of modern studies of socialization in the childhood, provides the pedagogical logic of the contemporary Open Education reform movement in Korea. Increasingly influenced by "non-foundational" social studies, the recent constructivist turn in educational studies has brought into fore the significance of context and discourse in understanding teaching and learning. Whatever its assumptions and claims are, it provides a rationale for reform-minded researchers and practitioners, and is a central locus of reform discourses. At the same time, there is a problematic regarding the persistence of educational reform, as seen in Western public school history, and the Korean case in some sense. A useful question presents itself: why is educational reform
so-persistent? The literature offers several explications of the reason, yet such explications rarely search for the reason within the everyday life of classrooms.

Rather than discussing programmatic claims and intentions, this study builds a description of actual practices in elementary classroom science lessons, and in this way offers an understanding of how indeed the contextual features of the everyday classroom lesson are shaping Korean educational practices in the early grades. It aims to show how, in the contextual details of everyday classroom lessons, order, knowledge and meaning are crafted. It brings into view the tasks and achievements of everyday classroom practices which every instructional innovation will encounter. This study describes the routine classroom organization of questions with known answers, and instructing and enacting demonstrations. Based upon its findings in the local settings, the study then discusses the possible limits of reform discourses, and their alliance to constructivism.

Whatever the instructional reform ambitions of a reform movement may be, those reforms will themselves take hold, or not, in fields of practical, social classroom activities, whose organizing practices are themselves remarkably stable and familiar. It is in light of the practical, discursive foundations of classroom order that we have reason to re-visit prior observations on the durability of classroom order and the organizations of activities that go on there, as matters of durable practice, for students and teachers alike.
Dedicated to my wife, and family
I wish to thank my advisor, Dr. Douglas Macbeth, for six years of support and encouragement. He led me to find a possibility of the study field in which we are involved in the educational study. His guidance through this study and writing phase was invaluable, including countless hours for conversation and a large amount of comment notes for the last six years. During this process, the apprenticeship for me to produce graceful works was there. Many ideas from his teaching have found their way into the pages of this thesis. His scholarly achievements have impacted on expanding my horizons enormously.

I would also like to thank Dr. Damarin, and Dr. Beeth for providing support for me to pursue my interest. While they have developed their own insight of the respective study field, they have been willing to understand my intention and work.

Thanks are also due to a few professors in Korea. This study is a result of their constant supports and concerns. My former advisor in Korea, Dr. Chang had shown me an exemplar of how to manage a disciplined life. His achievements in his area have been a source of an inspiration for me.

Finally, I am grateful to my mother, and family. Especially, my wife is always willing to be a virtual reader of my study. She never forgot encouraging me to further this study. She stands up with my absence and works successfully in her area. She was worth every sacrifice I had to make in order to produce my study for the last six years.
VITA

1986 - 1990..................................................B.A. Education. Seoul National University
1990 - 1995..................................................M.A. Education. Seoul National University
1996 - present..............................................Doctoral program. The Ohio State University

Major Field: Situated Learning Theory, Classroom Interaction, Qualitative Research Methodology in Education
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedication</td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>v</td>
</tr>
<tr>
<td>Vita</td>
<td>vi</td>
</tr>
<tr>
<td>Chapters:</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Literature Review</td>
<td>23</td>
</tr>
<tr>
<td>1. Open Education: The backdrop and plans</td>
<td>23</td>
</tr>
<tr>
<td>(1) The rise of Open Education and the expectation of democratic education</td>
<td>23</td>
</tr>
<tr>
<td>(2) Open Education in the Korean context</td>
<td>26</td>
</tr>
<tr>
<td>(3) The essential interest in principles for authentic pedagogy to re-organize classroom practice</td>
<td>31</td>
</tr>
<tr>
<td>2. Reform discourse and constructivism</td>
<td>36</td>
</tr>
<tr>
<td>(1) Constructivism: Its range and coherence</td>
<td>36</td>
</tr>
<tr>
<td>(2) The social constructivism and authentic pedagogy discourse</td>
<td>42</td>
</tr>
<tr>
<td>(2.1) Background of social constructivism in educational studies</td>
<td>42</td>
</tr>
<tr>
<td>(2.2) Socio-cultural constructivism in Vygotskian activity theory</td>
<td>47</td>
</tr>
</tbody>
</table>
(2.3) Situated learning theory and discourse of authentic pedagogy.........52

3. Authentic science education and constructivism ...........................................57
   (1) Constructivist discourse in science education .................................59
   (2) Social constructivist discourse and authentic science pedagogy ..........64
      (2.1) Authentic science pedagogy and new understandings of science in social studies of science ........................................66
      (2.2) Everyday practice and authentic science education ....................71

4. Persistence of instructional reform ............................................................75

5. Conclusion ..................................................................................................80

3. Methodology..................................................................................................82
   1. The routine grounds of classroom lessons: The tradition of inquiry into classroom interaction ..................................................82

2. Ethnomethodological studies of the routine ground of everyday practice......92
   (1) Ethnomethodological Studies...............................................................92
   (2) Key analytic concepts for the examination of local adequacy ............95
      (2.1) Indexicality ..................................................................................95
      (2.2) Reflexivity ....................................................................................96
   (3) Ethnomethodological respecification of sociology’s topics, including science ......97
   (4) Conversation analysis and discursive interaction ..............................100

2. The field and fieldwork .............................................................................106

3. The data and the procedure of analysis ......................................................110

viii
4. Questions with an known answers ................................................................. 114

1. Revealing answers in collective actions – A case of cohort-based instruction .... 120

2. The third turn evaluation .............................................................................. 129

3. Higher order questions within the local order of lessons ................................. 139

4. Discussion ..................................................................................................... 152

5. Instructing and enacting demonstrations ...................................................... 157

1. Demonstrations in science lessons ................................................................. 157

2. Demonstration, experimentation, and display of virtuosity ............................ 162

3. Instructing demonstrations .......................................................................... 166

4. Learning by enacting demonstrations ........................................................... 180

5. Discussion .................................................................................................... 207

6. Conclusion ................................................................................................... 212

Bibliography
CHAPTER 1

INTRODUCTION

1. Background of the educational reform in Korea

Since the 1990s, school reform has become a national issue of great interest in Korean society. It has seized interest in the public discourse as well as in the professional community of educators, and the phrase “Open Education” has led the national movement of instructional innovation. In ordinary classrooms, many educators and teachers have embraced programs of Open Education, and the Korean government has supported the movement and encouraged school teachers to implement Open Education in their classroom settings. What began as a movement restricted to a few private elementary schools has progressed into a nation-wide movement.

Open Education was first introduced in a few, mainly private, elementary schools in the 1980s by educators with an interest in progressive education, based by and large on models of Open Education developed in the US and Britain in the 1960s and 1970s (Eun, 1994; Kim, E., 1993). Though their interests were specifically in educational reform, the development of these impulses at this time is also tied to broader historical, economic, and cultural forces that are shaping the contemporary Korean context, for which the culture of Korean schooling has become emblematic.

Critiques of the psychological and pedagogical principles of direct instruction have
been one of the longstanding and shared concerns in instructional innovation in the Korean research community, as it has been in the Western literature. The problem concerning knowledge acquisition in school learning has been pointed out for a long time. For example, descriptive studies of Korean school practices have described the Korean classroom practices as *Gyogwaseo Hesulsik* lesson (textbook explanation), *Amjuksk* lesson (literal meaning, gruel for baby) or *Amkijuyipsik* lesson (indoctrination for memorization) (Kim, J. 1998; Lee, I. 1993; Lee, J, 1988). Those characterizations indicate imparting chunks of knowledge, especially specific bits of information to be memorized for examination preparation or teaching memorization strategy.

These characterizations of Korean school lessons, by and large, have to do with the culture of competition for university entrance. In Korean community, *Yipsigyoyuk* (education for entrance examination) is a popular image which characterizes Korean schooling. The culture of competition for entrance examination, which is spread from the college level even to the elementary level, has been in place for a long time. In the highly competitive culture of Korean education, classroom lessons have been conceived as a process of preparation for examination. Every competition from elementary school onward tends to be towards that of entrance to college level. In such an atmosphere, 'examination' becomes the motivating force of educational system, for students and teacher alike. This culture of examination has led parents to purchase their children's preparation for examination from private educational services and institutions. Nowadays, *Gwayo* (extra-curriculum learning out of school) or private institution of education is so popular that it threatens the normal curricular activities in public school. Many students have already learned their lessons out of school and attend school just to take a test. For example, it is common in Korean communities that many students learn fifth or sixth grade math from private tutors. One of the motivations for the Korean government to support the recent instructional innovation is thus to rehabilitate the public school as the primary site of learning for the nation's children.

Above all, the government wants to maintain equality of public education for all the school children, especially the lower class children who do not have access to extra-
curricular studies. How to build an organizational form that would allow teachers to teach students of diverse achievement levels in the same classroom without separating them into different classrooms or schools is part of the interest in, and promise of, Open education. It is a question of how to provide access to classroom knowledge equally. The fact that there are students who benefit from private education, Gwawoe, and students who do not benefit, including low-income children, together in one same classroom has haunted, as an educational problem, educators and school administrators. The concern is central to the public discourses on “the crisis of public schooling,” and is ubiquitous in the entire society. Thus, how to maintain educational opportunity for all students, instead of segregating students into different groups or schools, has become a critical issue for the successful management of public schools.

The interest in instructional innovation is not then only limited in its purpose for innovation of classroom methods. It also has to do with recent societal transformation. Since the Japanese colonial period [1910–1945] during which the nationally institutionalized school system was established, people have characterized the culture of Korean classroom as rooted in the Japanese style, including Japanese colonial policy. The modern form of public schooling in Korea was built along with the colonial policy in that period. Thus, people believe that the Japanese style of the colonial period still remains as a constituent part of the current practice in school classroom. In such a context, traditional school education has been regarded as reflecting the authoritarianism presented in the larger historical experience. The traditional model of classroom practice has been discussed as problematic in the minds of those interested in furthering the social movements for progressiveness and cultural identity championed in Korea since the 1990s. For example, some try to rehabilitate the Korean identity by returning to the traditional form of education before the colonial period (Kim, K., 1992; Lee, S. & Cho, Y., 1989). Those endeavors pursue historical data in order to prove that traditional Korean education took informal and individualized forms. Such assertions are often articulated in discussions of classroom lesson reform.

Some of the progressive educators among the older generation also have in mind that
the traditional classroom lesson does not fit the younger generation any more (a dialogue with the first president of the Open Education Association, 1999). They believe a discontinuity exists between the generations, which is more than a generation gap. They have observed a steep progress in socio-economic transformation since the Korean War, and this has led them to believe that more thorough changes in local areas marginalized under the shadow of socio-economic progress would be needed. The concern for childhood in the new era is one of those. The older generation has noticed that childhood is not the same as that of their generation. For instance, Sinsedae refers to new generation literally, but more than that, it implicates a legitimate shift in standard of cultural and societal value. While conservative people are negative about the change, progressive educators tend to be positive about such a shift. The latter, concerning the current school problems, tend to judge that school practices are out of date in comparison with the changes of the new generation.

These broader social forces have shaped the contemporary context of educational reform. As the Open Education movement has gained attention nationally, researchers and administrators have begun to introduce Open Education into public elementary schools all over the country. Educators and researchers have begun to develop lesson models fitted for ordinary classrooms. Educators and researchers have observed and studied the model of classroom lesson from other countries in order to learn more about specific reforms. They have also studied the Japanese model of Open Education as well as the Western models developed in the 70s and 80s (KOE& KEEA, 1994; Lee, D., 1999; Lee, Y. 1999; Lee, Y. et al., 1998), and above all, the concern has been to develop models which would be fitted to the Korean setting, instead of models from other cultures.

Open Education has thus become a nation-wide movement. Researchers and educators have organized regular national conferences and associations to support the implementation of Open Education. In 1995, the Korean government addressed Open Education as one of the national plans for educational reform (the National Committee of Educational Reform, 1995, 1996). The plan, which the government addressed, proposed
the ideal purpose of an 'Open Education society, life-long education society,' entailing the implementation of learner-centered education and a diversity of educational styles and opportunities. With support across the levels of government, Open Education has been encouraged in elementary schools all over the country. According to a report which was prepared for in-service teacher education concerning Open Education (Lee, Y. et al., 1997), half of the elementary schools in the country partly and unofficially implement some aspect of Open Education.

Open Education has thus been popularized as a social movement of school reform and thus a formal definition about what it could be like is not easy to find. Nonetheless, according to one report (Lee, Y et al., 1997), there could be agreement on the maxim, "individualized student-centered pedagogy" (p. 9). The report goes on to clarify how Open Education would change Korean classroom practices. Open Education would promote:

1. Individualized learning contents, methods and evaluation
2. Autonomy and self-directed learning
3. Active teaching-learning for students and teachers
4. Diversity of learning materials and environments
5. Flexibility in management of the curriculum and the lesson (p. 8)

Similarly a report concerning the 7th National Curriculum Development (1996) recommends new models to minimize direct instruction and maximize small group teaching and individualized learning and enhance interactions between teacher and students. Also, it recommends a flexible management of time and place for student-centered classroom lessons on the one hand, and on the other hand such practices are supposed to encourage students to make use of resources such as various learning materials in order to help them engage in classroom tasks. The 7th National Curriculum, which will be implemented in 2000, intends to restructure the national curriculum for such instructional practices.
These expectations provide a sense for the direction of the Open Education movement in Korea. With such an orientation, some schools have begun to restructure other aspects of the learning environment in order to support the new mode of classroom practice, including changing architectural forms, texts, and other instructional materials (Kim, H., 1996; Lee, J. S., 1997; Park, M., 1997; Shin, 1994). Although the movement lacks formal specification, its most distinguishing feature is perhaps the goal of establishing a much more democratic classroom atmosphere. Most of all, in Korean communities, progressive educational reformers have given their efforts to the democratization of classrooms along with changing the entire country's social and political climates. The advocacy of such reform springs from a concern about the inappropriateness of most school practices for the needs to cope with the complexities of the "so called" post-industrial restructuring of the social order. In particular, they have also to do with a shift from the longstanding system of military government to civilian government in the 1990s. In this atmosphere, the word of 'open' has come to apply to all levels of society. It represents an effort to remove obstacles to public accessibility and equity across the board, e.g., open music concerts, open parliament, open government, and open companies. Therefore, reform-minded administrators and teachers have sought out educational practices which will allow for diverse modes of student participation, and Open Education seems to afford such a promise.

When we consider how these -or any- reform proposals could be implemented, we very soon encounter the question of how to establish new practices in classroom settings. Such a concern presents itself when we consider the social nature of classroom practice. The primary concern in Open Education is how to transplant new modes of classroom practice such as more student involvement, active learning, informal relations between teachers and students, and connections to the larger world outside the classroom. In order for students to experience such new forms of curriculum, the rearrangement of classroom lesson organization such as time, space, or activity has been required. Many educators and teachers as well as researchers have given their efforts to the exploration of models adjusted to the Korean classroom context. In this process, the formal characteristics of
various models were discussed and suggested to school teachers.

2. The discourse of instructional innovation and constructivism

Instructional innovation which explores an alternative to the conventional classroom lesson has been as an enduring issue in educational studies. Explorations of new classroom organization for 'better teaching' have occupied an essential research topic in mainstream educational studies. In Open Education reform, calls for activity-based and child-centered lessons, or the social construction of classroom knowledge, have been suggested as a referent for classroom teachers to rely on for organization of new classroom lessons (Jung, J., 1993; Kim, E., 1993; Lee, D., 1999; Lee, Y., 1993, 1999). Meanwhile, such claims as the principle of 'open' classroom lesson methods are familiar across many public school reform movements, whether in the Western world or the Korean context (Barth & Rathbone, 1969; Bussis & Chittenden, 1970; Kohl, 1969; Marshall, 1972; Rogers, 1968; Rothenburg, 1989; Silberman, 1970; Spodek, 1975; Stephen, 1974; Weber, 1971). They are a part of the enduring discourses in educational studies which support the efforts to establish new modes of classroom practices. And when we turn our attention to the theories and claims upon which such reform discourses are held, we find a coherent collection of underlying assumptions. The theories and claims which are central to progressive reform discourses have been affiliated with the underlying assumptions of constructivism since the progressive education movement.

Above all, the constructivist discourse has provided a rationale for instructional innovation concerning the essential condition of learning and knowing. It has questioned the existence of any stable foundation for formal knowledge bases upon which knowing is constructed. Rather, it has called attention to the importance of individuals' or communities' construction of knowledge through making sense of the world. Based upon such a reflection on the condition of knowing, constructivist theories have suggested principles and methods for new organizations of classroom practices. More recently,
many reform-minded educators and researchers have asserted the needs for changing school practices based on the mass production of information and the changing nature of knowledge in a so-called 'post-industrial society' (Korean Association of Open Education, 1996). The constructivist discussions have provided a conceptual repertoire with which they inspect the 'formal' characteristics of current classroom lesson practices and simultaneously explore new models to accommodate the current social-cultural transformation.

Historically, constructivism has a unique status in educational studies. It has been offered as something akin to a secular religion in educational research. Whatever else it may be, constructivism is “powerful folk tale” about the origins of human knowledge (Phillips, 1995). Educational studies from the outset have been wondering about what is really going on in the apparatus of learning and inquiry, and it is hoped that constructivism would provide a key to opening the black box. John Dewey is one of the most acknowledged constructivists, especially in the area of educational studies. His writings on the social nature of learning and the reconstruction of schooling shaped the progressive education movement in US, which has also impacted the Korean community. As a matter of fact, the discourse which Deweyan progressivism initiated has been systematically reiterated in the history of educational studies, and we could assert, in some sense, that “most types of constructivism are modern forms of progressivism” (Phillips, 1995, p.11).

When one applies constructivism to the issue of teaching, one must reject the assumption that one can simply pass on information to a set of learners and expect that understanding will result. Communication is a far more complex process than this. When teaching concepts, as a form of communication, the teacher must form an adequate model of the students' ways of viewing an idea and s/he then must assist the student in restructuring those views to be more adequate from the student's and from the teacher's perspective. Constructivism not only emphasizes the essential role of the constructive process, it also allows one to emphasize that we are at least partially able to be aware of those constructions and then to modify them through our conscious reflection on that constructive process. (Confrey, 1990, p. 109, Recited in Phillips, 1995, p.11)

More recently, constructivist claims have taken on a more systematic theoretical position with which educators and researchers could pursue explorations of classroom models. That is, the social nature of knowing and learning which has remained a central discourse has received renewed attention. Turning from traditionally psychologically oriented educational studies, the educational research community began to re-consider the role of social context or activity in learning and knowing (see Greeno, Collins & Resnick, 1996). Through the examinations of knowledge-in-use with connections to "communities of practice" (Lave & Wenger, 1991) such as everyday settings out of school or the everyday practice of adult professional work, this branch of studies has taken up the nature of "authentic activity." It has provided a strong theoretical resource to support the idea of "authentic" conditions of learning and knowing in the innovation discourses. This can be seen in discussions of situatedness in learning and cognition (Brown, et al., 1989; Cobb, 1994; Greeno, 1996; Lave, 1988; Newman, Griffin & Cole, 1989; Perkins & Salomon, 1989; Resnick, 1989; Resnick, Levine, & Teasley, 1991; Rogoff & Lave, 1984). The discourse of situated learning, in educational literature, brings to the fore the idea that the social context in which our actions and thinking are engaged thoroughly pervades knowing and learning.
In particular, the discussions of the social construction of knowing and learning in the educational literature have been developed with an affiliation to Vygotskian activity theory (Brown, Collins & Duguid, 1989; Collins, Brown & Newman, 1989; Chaiklin & Lave, 1993; Lave & Rogoff, 1984; Newman, Griffin & Cole, 1989; Resnick, 1987, 1989; Rogoff, 1991; Salomon, 1993; Scribner, 1984; Wertsch, 1984, 1985, 1991; Wertsch, DelRio & Alvarez, 1995). This approach has emphasized the social nature of learning and knowing by building a theoretical model of how individuals co-construct meaning in the world and of how individuals appropriate collective knowledge. The social condition of learning and knowing has been treated as a stimulus for individual cognitive growth, and thus as the object of a theoretical concern with which this approach recommends a constructivist model of what an actual world of classroom practice should be.

Discussions of authentic pedagogy in the recent constructivist discourse have become a regular part of an instructional reform literature which posits its focus on the social nature of learning and curriculum in Western societies, and increasingly informs the innovation discourse in Korea as well.¹

¹ In the same way as reformist discourse is tied to the mainstream educational studies in each period, the expectations and beliefs of Open Education, within a background of larger social transformation, also runs parallel with recent shifts in educational studies. In educational studies, such a shift is not monolithic but diverse. In fact, there’s no way that Open Education movement in Korean context has only been stimulated by recent developments in the Western literature of social constructivism. Rather, it has been stimulated in the larger Korean sociocultural context. Nonetheless, it’s not surprising that these recent discourses on situated learning have been welcome by innovation-minded educators and researchers in Korea who explore rationales for instructional innovation (Kang, 1999; KOEA & KEEA, 1994; Whang, 1998).
3. The culture of mundane classroom lessons and its transformability

Innovation-minded educators and researchers have long explored new models of classroom lessons which fit well in ordinary classrooms. But in the end, the question of how to implement Open Education, or any other instructional reform, has remained as a task for classroom teachers in the context of their daily practice in the workplace. There is thus a long history of teachers working to develop and rearrange the organization of their classroom lessons, on the one hand, and on the other hand wondering how they are to do so. Alongside these histories, many scholars have observed that the teacher-centered lesson is a very durable organization, even in the face of efforts to move classroom lesson toward student-centered activity (Applebee, 1974; Applebee, Langer, & Mullis, 1987; Cuban, 1982, 1984; Goodlad, 1984; Hoetker & Ahlbrand, 1969; Stake & Easley, 1978; Suydam, 1977; Westbury, 1973). As Cohen (1990) observed, when a teacher believes herself to be fully aligned with a constructivist perspective in her classroom, she can still be far closer to her conventional practice than she imagined.

Many historians of education, from diverse perspectives, report that there has been persistence of reform throughout the history of public school in the Western community, even though each was not exactly as before, nor under the same condition (Aronowitz & Giroux, 1987; Cuban, 1987, 1989, 1990; Fullan, 1991; Popkewitz, 1988; Sarason, 1971, 1990; Tyack, 1990; Tyack & Tobin, 1994; Tyack & Cuban, 1995). As efforts for instructional innovation have been persistently iterated, each seems to reflect a difficulty for the realization of new models, where, as Cuban (1989) points out, there is no way to tell what would be success and failure, owing to variations in program settings and practices that context the reform efforts. As Tyack (1990) observes, where reform is concerned, “vague is vogue” (p. 170).

In the contemporary context of authenticity discourses, for example, we could be left wondering why it is so difficult to transplant into the ordinary setting of school classrooms new models which are assumed to facilitate authentic knowledge acquisition. The historians of education have found possible reasons about persistency of reform,
primarily in relation to the sociocultural backdrop. Such explanations suggest implicitly that if the external condition could be transformed, the authentic pedagogy in school education would be realized. Meanwhile, those explanations have neglected how the reformed features of authentic pedagogy would be possibly implemented at the local level of actual classroom settings.

Such a puzzle leads us to examine how the ordinary classroom lesson actually works. However, while the authenticity of classroom practice has been treated as a topical issue in the discourse of constructivist innovation, it tends to render the ordinary practices of classroom lessons impoverished and taken-for-granted. The contemporary reform discourse has treated ordinary classroom lessons as impoverished learning, owing to their reliance on formal, decontextualized practices, or ideological orientations to “failed epistemologies.” In consideration of these new instructional models, an understanding of how ordinary classrooms work tends to be neglected in the discourse of constructivist innovation. Speaking of the impulse to reform more generally, Cuban (1987) notes how this neglect leads to a cycle of recurring educational innovation.

Reformers...seldom ask the basic questions: How do teachers teach? Why do they teach the way they do? Instead, they frequently leap to the question: How should teachers teach? In doing so, these policy makers and practitioners often harvest disappointment from reform expenditures.... Thus the premature question – How should teachers teach? - yields a shallow conclusion for reform failures: intransigent teachers were to blame. Asking for prior, more fundamental, questions about existing practices and investigating what those practices yield produces a very different analysis. (p. 34)

On the other hand, an examination of how the ordinary classroom lesson works has not been entirely neglected in educational studies. It shows up distinctively in classroom interaction studies during the last two decades (Cazden, 1986; cook-Gumperz & Gumperz, 1982; Erickson, 1986; 1994; Erickson & Shultz, 1981; Heap, 1981; Macbeth, 1990, 1994, 2000; McHoul, 1978; Mehan, 1979; Payne and Hustler, 1980; Philips, 1972;
This approach, instead of taking the contextual character of knowledge acquisition as theoretical leverage for building a critique of the actual fields of classroom lessons, takes the social nature of order, meaning, and action as an analytic viewpoint from which we could examine actual occasions of classroom practice, and leads one to a quite different field of view of ordinary classroom lessons. According to this approach, interaction in classroom lesson occurs not so much in isolated acts of teacher and student, but as a collaborative production of the participants involved.

These studies remind us that we have taken for granted daily classroom practices, owing to the fact that it is so familiar and so non-problematic for the participants in the setting. By doing so, they have shown that ordinary classroom lessons have their own "grammar of schooling" (Tyack & Tobin, 1994) practices and socially-organized structures that sustain the work of instruction, which then deeply shape order and meaning for teachers and students alike in these settings. Shifting its attention from how teacher and students transmit and learn, this approach turns its interest to how teacher and students together act and coordinate socially constructed ways of 'doing classroom lessons' through a flow of classroom events. Without treating separately what is ordered in the setting and what is experienced by participants in the setting, this approach demonstrates how ordinary classroom lesson proceeds within and as the social organization of local settings.

If the mundane classroom lesson has its own setting-specific social organization which forms curricular activity, and if it is the routine which grounds the setting as stable and familiar, then we can wonder to what extent there are possibilities and limits to instructional reform? The impulse to reform implicates both 'undoing' what teachers in ordinary classroom have done, as well as formulating what they should do. In other words, a question can be raised concerning what could be durable and what could be transient in ordinary classroom lessons and practices. The question recurs whenever actual efforts for innovation have taken up explorations of new teaching models which would be available in the local context of classrooms. Such efforts are explicitly
concerned with exploring new teaching models, but implicitly they also examine the changeability of the ordinary culture of classroom lessons. Without an understanding of what classroom practices ground classroom lessons in the local context of the room, any introduction of new modes of practice could only leave us puzzled as to how it would actually work. In other words, when reform takes for granted what is actually happening in everyday classroom lessons, it unavoidably encounters the question of the possibility of change in the culture of mundane classroom lessons, and this is so whenever new principles or models of instructional innovation are proposed.

4. Science classroom as a field setting

This study pursues this problematic of instructional reform in the particulars of six science classrooms in four Korean elementary schools. The problematic of reform is no less familiar in the area of science education. In particular, the pursuit of “authentic” science pedagogy is an enduring interest in school science learning and in the general education literature, whatever the supportive theories and claims may be. Under the pursuit of Open Education, the 7th Korean National Curriculum in Science Education proposes several formulations of the principle. The National Guidance of Curriculum

---

2 McDermott & Webber (1998) call such a recurrent interest in organizing the reform of classroom science and mathematics education “an old format for new stories.” They articulate it as follows:

1. The content is defined as sometimes difficult and sometimes not, but always functional;
2. access is attained situationally and is ultimately available to anyone who hangs around long enough; and
3. teaching demands designing problems that model the real world and invite mastery as an outcome of participation. (p. 331)
(1999) indicates the general direction of instruction in elementary science education as follows. Teachers are encouraged to:

1. Elicit and utilize open questions
2. Teach fundamental inquiry process (observation, classification, measurement, anticipation, reasoning, etc.)
3. Encourage cooperative learning through group activities
4. Encourage student centered discussion
5. Provide information about science such as science articles in newspapers, biography of scientists, etc.

Along with such a general direction of classroom science is the intention to engage students in the authentic culture and tasks of science. Specifically, the guideline of the 7th National Curriculum indicates the direction with which experimental activities in science classrooms should be:

1. Acknowledge what experiments are about. Otherwise, students could develop the competency to manage tools, but would fail to develop a scientific attitude which would require inquiry ability.
2. Experimental activities should facilitate scientific attitude from students. For this, teacher should not reveal the outcomes before performing experiments.
3. Experiments should be simple and materials and tools easy to manage.
4. Encourage students to perform various ways of experiments.
5. Discourage students from making hasty conclusions.

The fact of the persistence of reform in science education, including constructivist reform discourses, is enduring seems the same as other subject matter lessons. The proposals above are closely tied to a canonical concern of science education for the last decades, in which the tasks of teaching students and designing the curriculum proceed
with the expectation that it is possible for students to discover for themselves the principles of a science. In particular, the idea of discovery learning represents one of the essential pedagogical principles for authenticity in general educational studies as well as science education studies. Constructivism in science education, whatever the positions are among the wide range of constructivist discussions (see Duit & Treagust, 1998; Duschl & Hamilton, 1992; Jenkins, 2000; Matthews, 1991; Miller, 1989; Kelly, Carlsen, & Cunningham, 1993; Tobin, 1993), has also undertaken such an idea and thus has provided "a referent for reforming science education" (Bentley, 1998, p. 231).

Above all, the perspective of cognitive constructivism has had a profound impact upon science education since the 1960s, which has found an instructional model for a child's own inquiry in the metaphor of the student as scientist (Carey, 1985; Chinn & Brewer, 1993; Driver, 1983; Hawkins & Pea, 1987; McCloskey, 1983; Posner et al., 1982; Vosniadou & Brewer, 1987). Such a model has worked as the most familiar principle to organize science classroom lesson. More recently, social constructivism has discussed, beyond the traditional individualistic constructivism, how social actions construct the collective knowledge of science, and brought to the fore the image of teaching as collaborative work with students (Cobb, Wood & Yackel, 1991; Cunningham & Helms, 1998; Driver, Asoko, Leach, Mortimer & Scott, 1994; Kelly, Carlsen & Cunningham, 1993; McGinn & Roth, 1999; Roth & McGinn, 1998a, 1998b). Social constructivism has suggested science teaching models which recommend the social nature of knowing such as activity or context as an engine for an individual student's development of scientific knowledge. In this way, constructivist notions support the idea of discovery learning.

In particular, what leads us to reconsider the possibility of the reform discourse and constructivist discussions in science education comes from the central place of the very idea of "authenticity" as criteria of a reformed model of science teaching. Recent social studies of science have problematized the idea of authenticity as a pre-given condition (such as unified methods) in which science would be accomplished, and have revised our traditional thought about the relation of scientific knowledge and ordinary actions. Such
a perspective has been informed by a renewed understanding of science which has emerged from scholarly endeavors in the history, philosophy and sociology of science (SSK) (see Collins, 1985; Knorr-Cetina & Woolgar, 1983; Latour & Woolgar, 1979; Lynch, 1993; Lynch & Woolgar, 1990; Pickering, 1992; Woolgar, 1988). According to this new understanding of science, science is no less tied to vernacular actions and ordinary social organization, even though the latter is not same as the former. The relevance of this perspective on science for this study is particularly important, not because it is expected that a better understanding of science would indicate a more correct direction for pedagogical efforts for authentic science lesson, but because we need to understand the extent of the limits which the very efforts to implement authentic science pedagogy could possibly encounter.

5. Research settings

This study examines how the intended, planned features for Open Education would appear in the practical circumstances of mundane classroom settings. The criteria to identify the implementation of Open Education is not identifiable at the level of physical feature of lesson organization (see Goodlad et al., 1970; Marshall, 1981). Instead, the principled features for Open Education are identifiable at the level of the teacher’s beliefs and attitudes about their lesson organization or administratively titled classrooms. Thus, I conducted participation observations in selected settings which reflected such factors.

For fieldwork, the schools that served as the observation settings are 7 classrooms in 5 different schools. The observations were conducted for four months, June-October in 1999. Three schools (B, H, P) are located in Seoul and the other one (J) is located in a small city which is four hours distant from Seoul. School H is private and the others are public schools. By and large, the students of the private school H come from the upper class in the Seoul area. About 60 percent of the parents have college level educational background. This school had addressed Open Education in earlier days, and the school
teachers have had a training for Open style education in foreign countries. However, this school does not formally use the title Open Education any more, but the school board believes their classroom activities have been formed in open style education. School P, on the other hand, is located in a school district whose students come from lower class families. In this school, fewer than 10% of the parents got college level education. In particular, some of the classroom lessons in P school were initiated in a project of Open Education affiliated to a university. School J belongs to a teacher's university in the city, and is a public school with well-established facilities. This school is titled an experimental school for Open Education in that area. The school B is located in a district of the middle class residence in Seoul. The class sessions observed in B school were designed and implemented by teachers who were trying to accommodate Open Education.

The specific settings for this study are science classrooms at the 4th, 5th and 6th grade levels. The participant observation lasted almost four months. The participant observation of one classroom in the P school was conducted two times a week. The observation focused mainly on the 4th grade science class in the school. The private school, H, was observed for two weeks mainly focusing on the 4th and the 5th grade level, with two and three visits to each class, each week. The B school was observed twice in the fifth grade level classroom. In one class session in each other of 5th and 6th grades in J school, and the first grade in K school were also observed. The data from the observations rely on audiovisual records and field notes of each session.

6. Research questions

Reform models and discourses have proposed to transplant new social organization in ordinary classrooms which would facilitate “authentic” curricular activities. In addition, theoretical considerations of “authentic” knowledge acquisition in educational studies have provided the principles and models for instructional innovation for the last few decades, and have been more systematically treated and developed in recent discussions.
of constructivism. Nonetheless, the reform of classroom practice tied to authentic learning discourses has been persistently iterated throughout the history of public schooling, and reform movements recur nowadays in the Western communities as well as the Korean community. Such a persistence of classroom reform seems to reflect alternatively on the difficulties of classroom reform, and on the stability of ordinary classroom settings.

At the same time, studies of classroom interaction have demonstrated the social organization upon which ordinary classroom lessons are already constituted. If the mundane classroom lesson has its own social organizations that shape the curriculum for the participants in the setting, then we can be led to wonder to what extent the implementation of instructional innovation would be possible. In other words, we could ask what could be durable and what could be transient in ordinary classroom lesson. This task requires a more close investigation of the settings and their activities. Thus, this study conducts a case study of classroom science lessons in the context of the Korean Open Education movement, focusing on everyday practices in six different Korean elementary science classrooms, and treats specifically the following research questions:

1. What are the mundane social organizations of classroom lessons routinely observed in these science classrooms?

2. How would the mundane social organization of classroom lessons appear in relation to the planned features for authentic science lessons?

3. How does the social organization of science classroom lessons shape curricular activities for teachers and students together?

4. What would the durable conditions of mundane classroom practices be? What would the findings of this study imply for the scope and limits of the discourse on instructional innovation in the Korean context?
7. Research perspective

Analytic exemplars for the proposed study rely on various resources for detailed descriptions of classroom practice. The analytic task is to describe the social organization of classroom practice in Korean elementary science classrooms, where those organizations are overwhelmingly matters of social action and discursive interaction. These descriptions would be distinctively context sensitive, showing how students and teachers collaboratively construct the local context, and thus the sense and order, of their lessons. The more familiar context-stripping techniques of formal analysis, most familiar as techniques of coding and categorization, which assume a separation between meaning and context, are not appropriate for the study of context-dependent phenomena.

Instead, this task requires a contextual approach in which the contextual organization of mundane practice of classroom lessons would be described. As Mishler (1979) points out, as a topic, meaning as context-bounded activity has been excluded from the main tradition of theory and research in educational studies. Nonetheless, the approach to treat contextual practices in everyday classroom lessons in its own is not so unfamiliar in educational studies. It can be found in the literature of classroom interaction studies (Cook-Gumperz, 1977; Erickson & Mohatt, 1982; Erickson & Shultz, 1977, 1981; Mehan, 1978, 1979; Philips, 1972). These studies have suggested an alternative to the linear, causal process-product model of educational studies, as illustrated in the tradition of interpretative studies of classroom pedagogy (see Cazden, 1986; Erickson, 1986, 1994 for reviews). These studies have been conducted by various lines of social inquiry, including ecological psychology, phenomenology, sociolinguistics, symbolic interactionism and ethnomethodology (Mishler, 1979).

In order to pursue systematically the interest at hand, this study will rely on ethnomethodological studies of situated actions for its analytic perspective. This study has presumed that there could be routine grounds of everyday classroom practice, for which reform efforts may have little if any effect on them. Ethnomethodological (EM) studies have taken up the analysis of the routine grounds of daily practice in everyday
settings as a topical concern. Garfinkel (1967), the initiator of ethnomethodology, notes that familiar scenes of everyday activities, treated by members as the "natural facts of life," are massive facts of their daily existence, both as a real world and as the product of activities in real world. EM approaches the routine grounds of social events as empirically investigatable, and is concerned with the practical, mundane methods people use to achieve coherence in everyday life, and how they make sense of their world so that the stable and recurrent features of everyday life, including order, meaning and structure, emerge (see Button, 1991; Garfinkel, 1967; Heritage, 1984; Lynch, 1993). Rather than theorizing the social nature of learning or classroom lessons, or the construction of meaning, via discourses on, e.g., ideology, power, or other formal structures which are assumed to be situated in the actual world and constrain folk's practice and belief, this analytic perspective treats fields of ordinary action as *sui generis*, and the site of social order and meaning.

Such an understanding of the organization of mundane social worlds leads ethnomethodologists to the descriptive analysis of social order as the achievement of everyday, locally situated practices. Central among those practices are the organizations of everyday discourse, or talk-in-interaction. Natural conversation is a massive domain of order and practice, and perhaps the most developed program of ethnomethodological analysis has been the sequential analysis of natural conversation. Conversation analysis has emerged as a systematic analytic program of discursive interaction (Heritage, 1984; Levinson, 1983; Sacks, Schegloff & Jefferson, 1974; Schegloff, Jefferson & Sacks, 1977), and has also provided essential analytic tools for the study of classroom interaction (Heap, 1981; Hester & Francis, 2000; Macbeth, 1991, 1994; McHoul, 1979; Mehan, 1979; Payne & Hustler, 1980; Sharrock & Anderson, 1982). These programs provide an appropriate perspective for understanding the durable conditions and practices of the mundane organization of classroom science lessons, in the context of the Korean Open Education reform movement.

8. Significance
Rather than discussing programmatic claims and intentions, this study builds a description of actual practices in elementary classroom science lessons, and in this way offers an understanding of how indeed the contextual feature of everyday classroom lesson are shaping Korean educational practices in the early grades. It aims to show in the contextual details of everyday classroom lessons, how order, knowledge and meaning are crafted. It brings into view the durable condition of everyday classroom practices which any instructional innovation will encounter. Especially, this study hopes to enlarge the repertoire of understanding of classroom practices with which the researcher can examine the scope and limits of the discourse on instructional innovation.

A further premise of the study is that whatever the instructional reform ambitions of a reform movement may be, those reforms will themselves take hold, or not, in fields of practical, social classroom activities, whose organizing practices are themselves remarkably stable and familiar. It is in light of the practical, discursive foundations of classroom order that we have reason to return to prior observations on the durability of classroom order and the organizations of activity that go on there, as matters of durable practice, for students and teachers alike.
CHAPTER 2

LITERATURE REVIEW

1. Open Education: The backdrop and plans

(1) The rise of Open Education and the expectation of democratic education

The expectation for humane, democratic education is historically long-standing and recurrent in Western communities as well as the Korean context. Open Education has been one of the popularized movements for democratic education. It is in no way to identify humane, democratic education movement as same under the name of Open Education, but they share interests in realization of democratic education against the conventional authoritative, formal lesson practice in school.

Open Education began in the English infant (kindergarten-second level grade) schools in the 1960s and their advocacy of alternative to school education. This form of education, at first, was developed as a reform movement of informal schooling by local teachers and educators, and was officially accepted later by the British government in the 1960s. The report “Children and their primary schools” (United Kingdom Department of Education and Science, 1967), commonly known as the Plowden Report, affirmed the legitimacy of such a reform movement. It was the report of an Advisory Council for Education (chaired by Lady Plowden) which was commissioned by the government, and the report received more than usual attention, and made an enormous impact on policy in
the primary level schooling. The report drew upon the achievements of the contemporary
development psychology, and tried to build new practices to treat the child as an agent for
his or her own learning. It recognized and authenticated a more informal style of
teaching and learning that had gradually been demanded in English primary schools for
the previous 40 years.

Later, the English style of Open Education impacted the United States from 1960s to
early 1970s. In the United States, it was like a revival of “progressive education” in the
1910s and 1920s (Rogers, 1968; Stephen, 1974). Progressive education, with its
antipathy for adultocentric views of children and a transmission view of education, had
been a dominant theme early in the twentieth century in the US. The impact of
progressive education was so large that experimental schools were built to implement this
new style of education since 1890, and the respective association was organized and its
journal was published in the early 1900s (Cremin, 1964). Since 1940, the progressive
movement has declined, never making peace with disciplinary-centered view of
education. Its claim of child and activity-centered education was criticized by educators
who argued for a discipline-centered education, along with the change of the national

---

For example, the Plowden committee argued that “Verbal explanation, in advance of
understanding based on experience, may be an obstacle to learning, and children’s knowledge of
the right words may conceal from teachers their lack of understanding” (para. 535). It reflects
the Piagetian influence on instruction in those days. The committee explicitly espoused
Piagetian theory:

Piaget’s explanations appears to most educationalists in this country to fit the observed facts
of children’s learning more satisfactorily than any other. It is in accord with previous
research by genetic psychologists and with what is generally regarded as the most effective
primary school practice, as it has been worked out empirically. The main implications of that
practice are described in the following paragraphs and, where relevant, reference is made to
the support given them by the Piagetian school of thought. (Plowden Report, para. 522)
policy to counter the national crises in those days and thus has perished. The interests in human rights or freedom in the 1960s, however, revived the expectation of more democratic educational forms, and the English style of Open Education drew attention from the U.S reformists.

Simultaneously, the impulse of the school reform movement towards democratic education was formed against larger socio-cultural backdrops. In the case of England, Open Education was accelerated in response to the unique situation after World War II (Rothenburg, 1989; Silberman, 1970; Weber, 1971). In the after-war situation, in which inequality of benefit of education was increased, people demanded to organize different-leveled students into heterogeneous groups, and English educators began to seek ways to teach students of diverse achievement levels in the same classroom. Also, many people in the 1960s had been influenced by counterculture movement in those days, and thus complained the school culture as repressive and authoritarian, and were receptive to school reform (Fantini, 1973; Rothenburg, 1989). Impressed by what appeared in elementary schools in England, American educators adapted the same ideas.

The issue of restructuring of schooling like Open Education has its roots in the socio-economic transformation in contemporary society. In particular, there is a rising need for new skills and qualities in, so called, “postindustrial society” since the 90s. For example, Schlechty (1990) issues restructuring of schooling, in which he argues that the existing mode of schooling is more suit to late 19th- and early 20th-century preoccupation with mass education in basic skills, rigid educational selection for future work roles that are expected to remain fixed over time. However, the need in “postindustrial” society is getting more complex, and thus it requires that children should be construed as ‘knowledge-workers’ and schools are defined as being in the business of ‘knowledge-work.’ Schlechty notes:

It is reasonable to expect that, as the American economy becomes more information based, and as the mode of labor shifts from manual work to knowledge work, concern with the continuous growth and learning of citizens and employees will increase. Moreover, the
conditions of work will require one to learn to function well in groups, exercise considerable self-discipline, exhibit loyalty while maintaining critical faculties, respect the rights of others and in turn expect to be respected. This list of characteristics could as well be a list of the virtues of a citizen in a democracy. (Schlechty, 1990, p. 39, cited in Hargreaves, 1997, p. 340)

In such circumstances, there is an agreement that Open Education has declined in recent decades, but similar claims and movements for school reform never cease and are historically recurrent (Rothenberg, 1989). The Open Education movement in the Korean community since the 1990s is one of them. Generally, the form of Open Education in Korea varies in the degree to which they implement various features of Open Education in different national contexts. In fact, Open Education in Korean context (OEK indicates the Korean case) is not the same as that of the Western communities in the 1960s and 1970s. The background in which the movement or the form of Open Education in Korea is shaped would be unique. For the interest in instructional innovation is not only limited to its purpose for innovation of classroom lesson method, but also has to do with a transformation of the entire culture of the larger society.

(2) Open Education in Korean contexts

Open Education in Korea (OEK) was first introduced in a few private elementary schools in the 1980s by educators with an interest in progressive education. The educators pursued the models of Open Education developed in the US and Britain in the 1960s and 1970s (Eun, 1998). They were enthusiastic to transform the traditional structure of classroom lessons (personal interview with Y. Eun, the first president of the OEK Association, 1999). In addition, the socio-economic backgrounds of these private schools allowed them to pursue new forms of education and Western models.

OEK attracted attentions from those who were enthusiastic for school reform and eventually developed into a national movement. Researchers and educators have organized regular national conferences and associations to support and implement OEK.
Since 1995, the Korean government addressed OEK as one of the national plans for educational reform (the National Committee of Educational Reform, 1995, 1996). The plan which the government proposed expressed the ideal purpose of an “Open Education society, life-long education society,” entailing the implementation of learner-centered education and diversity of educational style and opportunities. With support across the levels of government, OEK was recommended to elementary schools all over the country. According to a report which was prepared for in-service teacher education concerning Open Education (Lee, Y., 1999), half of the elementary schools in the country partly and unofficially accepted Open Education in 1997.

The efforts to transform classroom lesson culture included curriculum reformation. Usually, textbooks are reformatted in a cycle of five years in Korea. The issue of Open Education was central in the orientation for the 7th National Curriculum Development. A report concerning the 7th National Curriculum Development (1996) recommends new models to minimize direct instruction and maximize small group teaching and individualized learning, and enhance interactions between teacher and students. It also recommends a flexible management of time and space for student-centered classroom lessons. Such practices are supposed to encourage students to make use of multiple resources, such as various learning materials, in order to help students engage in meaningful classroom tasks. The 7th National Curriculum, which was implemented in 2000, intends to restructure the national curriculum for such instructional practices.

One of the most attentive concerns of OEK is to pursue a main pedagogical principle which indicates that the curriculum content should be treated in relation to how to teach and learn it. The idea presumes that education, in particular in “knowledge education,” should consider individuals’ interests and readiness. Here, appropriate acquisition and use of knowledge is a primary concern, which is to teach contextual knowledge and skills rather than abstract forms of knowledge. As a matter of fact, the establishment of contextual knowledge in classroom lessons as an alternative to direct instruction has been one of the long-standing and shared concerns for instructional innovation in the Korean community. The problem of knowledge acquisition in school learning has been pointed
out for a long time. Studies about Korean classroom culture represent it well (Lee, I. 1990; Lee, J. 1988). They have characterized the Korean classroom practices as Gyogwaseo hesulsik lesson (textbook explanation), Amjuxsik lesson (literal meaning, gruel for baby) or Amkijuyipsik lesson (indoctrination for memorization). Those characteristics indicate imparting chunks of knowledge, especially specific bits of information memorized for examination preparation or teaching memorization strategy.

Such a distinctive characteristic of the Korean school lesson has to do with the culture of competition for university entrance. In Korean community, yipsigyoyuk (education for entrance examination) is a popular image which characterizes the Korean schooling (Han, J. 1984). Whenever many policies and reform movements concerning education are issued, it has been discussed as the most central education problem. The culture of excessive competition for entrance examination, which is spread from the college level even to elementary level, has been at issue for a long time. In the highly competitive culture, classroom instruction has been conceived as a process for a preparation for examination. Every competition from the elementary school onward tends to be towards that of entrance to college level. There is a common belief that the level and name of the college from which one graduates strongly determine his future social and professional life. The well-known image, Hakryuck Sawhoi (literal meaning, schooled competency-centered society) represents such circumstances. Thus, educational studies (Kim, J. 1997; Lee, I. 1990; Lee, J. 1986) describe how efforts for entrance to better schools or better universities have become a dominant factor which controls the entire educational system and organization in Korea.

In this respect, OEK advocates the equality of educational opportunity. Lee, Y. (1998) pursues the design of OEK for the purpose of building instructional forms that would allow teachers to teach students of diverse achievement levels in the same classroom. It is a matter of how to provide equal access to classroom knowledge. For the fact that there are both students who enjoy the benefits of Gwawoe (extra-curricular private education) and students who do not together in one same classroom posits a trouble source for educators and administrators. In a similar context, Lee, I. (1993)
describes students in one classroom as those students who are eager to study and those who are eager not to study. She points out that the current classroom lessons do not satisfy both groups of students and loses the function of schooling as public service. The public discourse on the crisis of public schooling in this respect is ubiquitous in the entire society. Thus, how to maintain various students in one same group instead of segregating students into different groups or schools has become a critical interest for successful management of public school.

On the other hand, such a characterization of Korean classroom practice implicates more than knowledge acquisition. According to Lee, J. (1988), it has to do with a matter of social-cultural context of classroom instruction, which reflects the culture of larger society. In his study of the Korean school culture in the 1980s, Lee, J. (1988) examines why it is so difficult to implant inquiry lesson, the Western lesson model, for the last two decades in the Korean context. He suggests that the culture of inquiry might not be appropriate for the Korean culture. For the Korean culture, Amjukseik lesson would be a survival strategy for a teacher and students, while inquiry method does not provide survival values for them. According to him, people would need to alter their various perspectives and behavioral modes in order to implant new style of teaching. He argues that people should de-construct all the behavioral patterns about lesson methods for transmission which has been the custom since the Japanese colonial period [1910-1945], in which the modern public school system was formed, and re-socialize it with inquiry-patterned behavior.

Kim, Y. (1995) gives attention to the fact that the post-colonial influence remains in the Korean classroom lesson management, and determines the classroom culture. In particular, he depicted the image of ordinary classroom practice which resulted from highly managed control of students’ bodily movement in lesson time, e.g., how to sit on chair, how to bow, how to write, how to present, how to ask a question, etc. Such a depiction of the routine classroom lesson reaches into authoritarianism in language use in classroom lesson, e.g., the use of highly classified terms such as terms which show a respect for teacher. In this way, he demonstrates the disciplinary atmosphere represented
as etiquette in group life. As a reason for such authoritarian circumstances, Lee, J. (1988) points out that the Korean school culture is a culture of the elders in school, such as seen in teacher-centered, adult-centered and administrator-centered school management, and that adult-centered authoritarianism in education might be a byproduct of Confucianism. Confucianism has been a core principle to govern formal and informal education for centuries. It has emphasized a respect of the elders and what is received from them a virtue of the primary morality. It is commonly accepted that educational effects should be working in a rigorous atmosphere in which children’s mind and body can be disciplined under the adult’s responsibility.

Such formal characteristics of classroom lesson culture as an authoritative form lacking in autonomy have been pointed out as a chronic problem. Thus, some studies have tried to rehabilitate the Korean identity in the traditional form of education before the colonial period (Cho, Y., 1995; Kim, K., 1992; Lee, S. & Cho, Y., 1989). They have found an archetype for better teaching in the form of the traditional education system, e.g., Seodang Gyouk (private education of Confucianism) before the current urbanized public school system in the Japanese colonial period. Such studies attempt to describe the traditional education forms as informal and individualized organizations. According to them, Hunjang (master) in Seodang not only taught literacy to the students, but also he organized a curricular text which was appropriate for an individual student’s level. After the whole class lesson, Hunjang and then Jubjang (the first student) encouraged the students to interact with them. Such traditional models of classroom practice have been discussed by those interested in furthering the social movements for progressiveness championed in Korea since the 1990s.

(3) The essential interest in principles for authentic pedagogy to re-organize classroom practice

Open Education has been popularized to the level of a social movement of school reform, and thus a formal definition about what it could be like is not easy to find. Various attempts have been made to define the concept of Open Education in Western
literature (see Barth & Rathbone, 1969; Bussis & Chittenden, 1970; Kohl, 1969; Marshall, 1972; Spodek, 1975). However, as Marshall (1981) points out, the ambiguities in definition and the variations in degree of implementation of Open Education have brought forth the lack of consistency across studies.

The claims of Open Education drew its intellectual roots from early modern thinkers such as Pestalozzi, Comenius, Rousseau (Weber, 1973). Some formulations employ Dewey's progressivism, and some reference Froebel's or Piaget's directive which explicates children's unique skills and knowledge. Many influential books written by social reformers which praised open classrooms became bestsellers and thus disseminated the idea of Open Education to the public (Barth, 1972; Kohl, 1969; Silberman, 1973; Weber, 1971). For example, Charles Silberman, in his widely read book, Crisis in the classroom (1970), described English Open Education as "the keystone in the arch of educational reform" and recommended that American schools adopt a more humane education. The proponents and their writings have powerfully encouraged school teachers to free children's imagination and creativity from deadening routines, tyrannical authority, and passive learning.

The planned features or purposes which Open Education pursues are often formulated in very dichotomous terms, which show a contrast to the traditional classroom practice. First of all, the classroom session titled with Open Education shows a different organization which includes apparently visible formal features, e.g., more students' time, less teacher's lecture or direct teaching, increasing students' flexible use of space, project works, etc. However, the dichotomous definition of Open Education, once it encounters actual circumstances of classroom lesson, seems to get ambiguous. Thus, instructions for Open Education often recommend the teachers to consider classroom openness as continuous rather than a dichotomous variable (Lee, Y. 1998). Above all, it is so because there is no way to find out a set method or collection of activities to implement Open Education in the "right" way. What sense the form of Open Education would make to the teacher depends upon the teacher herself who implements the lesson. Thus, the criteria with which we determine a setting as Open Education or the traditional education seems
virtually very idiosyncratic.

Such ambiguity in deciding criteria would be more distinctive when we find in actual classroom lessons far more familiar practices on the one hand, and on the other hand, a new shape of organization of the whole lesson. Rather, to notice such a familiarity in daily classroom practice leads us to notice the discrepancy between what teachers believe is important in structuring a classroom and what they believe they are actually able to implement (Marshall, 1981), or between teachers’ perceptions of their innovative behavior and those of observer (Goodlad et al., 1970). For instance, Marshall (1981), in his study of Open Education, notes that classrooms may or may not be taught in a manner corresponding to the label. According to him, investigators, hence, may be basing their conclusions on classrooms which have been classified as open, but which in reality may not be implementing the essential components of the model. Such studies, as he points out, may be evaluating a “non-event.” Silberman (1973), who was sensitive to any dilution that might sap the vitality that teachers brought to their classrooms, warned as follows:

By itself, dividing a classroom into interest areas [learning centers] does not constitute Open Education; creating large open spaces does not constitute Open Education; individualizing instruction does not constitute Open Education.... For the open classroom... is not a model or set of techniques; it is an approach to teaching and learning....Thus, the artifacts of the open classroom — interest areas, concrete materials, wall displays — are not ends in themselves but rather means to other ends.... In addition, open classrooms are organized as to encourage:
1. Active learning rather than passive learning
2. Learning and expression in a variety of media, rather than just pencil and paper and the spoken word;
3. Self-directed, student-initiated learning more than teacher-directed learning.... (p. 297-298)

Thus, the very feature of Open Education tends to appear as teachers’ beliefs or
attitudes towards instructional decisions. Here, Open Education tends to indicate a set of beliefs or philosophy held by a community or “general understanding within the educational community” (Marshall, 1981, p. 189). For example, Horwitz (1979) has summarized such a general understanding of Open Education as “a style of teaching involving flexibility of space, student choice of activity, richness of learning materials, integration of curriculum areas, and more individual or small-group than large group instruction” (pp. 72-73). Traub (1972) demonstrates the feature of Open Education as follows; students’ decision of learning aims, non-fixed use of time and space, students’ autonomous learning, use of non-standard criteria of evaluation, and students determination of their classroom practice, etc. Tunnell (1975) formulates explicitly such features:

I. Students for themselves can choose the activity they want to do.
II. The teacher constructs the learning environment which gets students to have fruitful experiences.
III. The teacher implements individualized instruction which is meaningful for individuals.
IV. The teacher respects individual students.
   (4.1) The teacher permits a considerable amount of freedom in which students pursue their own interests.
   (4.2) The teacher encourages interaction between himself and students.
   (4.3) The teacher minimizes commands to students.
   (4.4) The teacher respects students’ emotional conditions. (p.17)

Such general beliefs which underlie all the teacher’s instructional decisions are defined in planned features or goals. In the Korean case, according to one report presented to a forum on Open Education, there could be an agreement about a maxim, “individualized student-centered pedagogy” (p. 9). Educators and researchers who design Open Education assume that “[A]bstract thinking gets a concept and plausible meaning when it is carried out along with concrete experience together” (Lee, D. 1999, p. 12). The
report goes on to clarify requirements with which Open Education could get its shape in classroom practices as follows:

1. Individualization: learning contents, methods and evaluation
2. Autonomy: self-directed learning
3. Active teaching-learning: students' active participation and teacher's active role
4. Diversity: diversity of learning materials and environments
5. Flexibility: flexible management of curriculum and lesson. (p. 8)

These features provide a sense for the efforts which have been given to instructional innovation. With such an orientation, some schools have begun to restructure other aspects of the learning environment in order to support the new mode of classroom practice, including changing architectural forms, texts, and other instructional materials (Kim, H., 1996; Kim, M., 1996; Lee, J., 1997; Lee, N., 1996). The coherently supported ideas and claims mentioned above are principled features with which teachers are to rearrange Open classroom organization (Kim, M. 1996; Lee, D. 1999; Lee, J. 1997; Lee, N, 1996; Lee, Y. 1998; Park, M. 1997). They have to do with how to rearrange time and space in a direction to increase students' autonomy, and go to a question about how to transform fixed or teacher-oriented time and space to increase students' autonomy, to make use of time and space and their activity. The concern contains largely two principles.

First, the claim of "child-centered" is as an enduring underlying principle to build an organization of classroom practice, even though many educators and researchers assert that it should not be same as what the progressive movement had claimed. From the past experience of the progressive reform movement, in which educators often assumed that a teacher's interruption would be prohibited, they acknowledge that a minimum teachers' interruptions in students' activity is unavoidable, instead of accepting the literal meaning of the principle. Thus, they suggest that teachers must find the best organization of time, material, and space to meet the needs of their students.
Secondly, whenever the re-organization of classroom practice would be recommended, it emphasizes the social nature of learning and knowing. Its primary concern is to suggest an alternative to the transmission model of instruction. First of all, it pursues activity-based learning such as hands-on learning, guided discovery, or problem solving. The policy in Open Education recommends various formal characteristics of how to rearrange time, space in order to facilitate activity-methods such as discussion, cooperation or active inquiry. It emphasizes curricular activity with the connection to the value of the society out of school. The policy recommends, rather than making use of fixed textbooks, the practical knowledge of everyday life, simulation of professional works such as courtroom, science lab, writers, actors, or use of newspaper articles, tools, experimental materials, encyclopedia, computer networks, etc. The matter of reorganization of classroom practice has been led to a question of how to encourage students to engage in such social contents of learning.

Educators and researchers have explored and developed the discourse of these principled features. Such principled features are centralized in the reform discourse. Educators and researchers, with the reform discourse, have appealed to school teachers to transform their beliefs and attitudes about their professional work. On the other hand, when we turn our attention to the reform discourse, we could notice that such a discourse is not so unfamiliar, but enduring as pedagogical maxims for the last a few decades. This is so in the Western context as well as in the Korean context. When we turn our attention to the Western history of educational reform and educational study, we can quickly notice that the reform discourse is coherent through the earlier constructivism of the progressive education, to recent constructivist discussions. The discourse concerning the beliefs and attitudes has been an essential orientation of education among the reform-mind educators. Whenever educational reform is publicly issued, this discourse works as a repertoire of it.
2. Reform discourse and constructivism

The expectation of humane, democratic education and the emphasis on the social nature in learning and knowing are widely distributed in educational studies, whatever their theories or claims may be. The effort to establish new classroom practices which focus on child-centered, activity lesson methods has been, manifestly or not, tied to constructivist discussions throughout this century. Constructivist discussions, above all, have raised criticisms of the cultural transmission approach to education, especially concerning when school practice is examined. Constructivist discussions provide not only a foundation for the legitimacy of the claim for child-centered lessons but also for context-based knowledge acquisition or activity methods in learning and teaching. They are not only widely ranged but also historically rooted in various scholarly endeavors in educational studies. Whenever instructional reform or its discourse is reiterated, constructivist theories or assumptions have provided an essential repertoire for an exploration of the possibility of an alternative organization of formal classroom practice. In particular, the recent development of “authentic” pedagogical discourses, along with an interest from social constructivism, has further elaborated the essential repertoire for instruction innovation.

(1) Constructivism: Its range and coherence

Over the last decade, constructivism has been discussed as a kind of panacea in educational research (Phillips, 1995). It has been part of a larger a theoretical reflection of the condition of knowledge production embracing the discussion of the social nature of learning and knowing in educational studies. Constructivism brought an issue of knowledge acquisition and production to the fore in the discussion of learning and teaching, and is expected to show a key to open the “black box” of what’s going on actually in the apparatus of learning and inquiry (Bereiter, 1985; Lawson & Staver, 1989; Petrie, 1980). Such an expectation partly comes from the fact that constructivism does not anchor such an apparatus on fixed or determined external entities, but proposes to
explicate the internal, social process of the apparatus. As far as instruction and learning studies are concerned, constructivism has been influenced by various schools that have strongly influenced educational studies; e.g., Dewey’s social constructivism, von Glasersfeld’s (1989) radical constructivism, Piaget’s genetic epistemology, and Vygotsky’s social constructivism of cognition.

Most of all, John Dewey is perhaps the most widely recognized proponent of instructional innovations related to experimental modes of participation in the classroom in Korean community as well as US. In his day, Dewey’s intentions for education were to increase the public’s accessibility to knowledge against experts’ monopoly on knowledge (Westhoff, 1995; Wirth, 1966). With such intentions, Dewey pursued the democratization of the school as a social community. First of all, Dewey gave the attention to the social nature of learning. Dewey turned to his idea of “occupations” for the pedagogical purposes of integrating his theory with school practice. Dewey observed in his notion of the occupations that “so fundamental and pervasive is the group of occupational activities that it affords the scheme or pattern of the structural organization of mental traits” (Dewey, 1931, pp. 220). He proposed classroom activity methods in which participation in occupational activities was learned, and created tasks for classroom curriculum to do so, e.g., move about, discuss, experiment, work on communal projects, pursue research outdoors in the field and indoors in the library and laboratory, etc. The idea is that students “learn by doing,” which typically means that students learn by actively manipulating objects and events, and that socio-physical engagement with a task is a necessary and sufficient condition for learning. It is well-known that Dewey’s assumptions concerning the social nature of learning became the central idea of the progressive education (Wirth, 1966). As Phillips (1995) points out, “most types of constructivism are modern forms of progressivism” (p. 11), and Dewey is one of the essential figures in constructivism (see Garrison, 1995, 1996; Prawat, 1995, 1996 for recent reconsiderations of Deweyan constructivism).

There is no theoretical consensus among widely ranged constructivist writers. However, there is, by and large, an agreement that constructivism begins with a critique
of naive realism or naive objectivism. While the latter assumes that our knowledge correspondingly represents the object or the nature and thus it would be factual information, the former accepts the idea that the apparatus of the human subject constructs nature (object) (Woolgar, 1988). In other words, it claims that human knowledge — whether it would be bodies of public knowledge, or the cognitive structures of individual knowers and learners — is the result of constructive activity as and within the subject's experiential world.

Such an assumption in constructivism has been accepted as a theoretical model which can critically reflect on the nature of knowledge in the school curriculum. Constructivist writers have pointed to the objectivism impact in the nature of knowledge which 'formal' lessons transmit. For example, von Glasersfeld (1989) notes that "the existence of objective knowledge and the possibility of communicating it by means of language have traditionally been taken for granted by educators" (p. 121). He continues:

The notion that knowledge is the result of a learner's activity rather than that of the passive reception of information or instruction, goes back to Socrates and is today embraced by all who call themselves "constructivist." However, the authors whose work is collected here, constitute the radical wing of the constructivist front.... This attitude is characterized by the deliberate redefinition of the concept of knowledge as an adaptive function. In simple words, this means that the results of our cognitive efforts have the purpose of helping us cope in the world of experience, rather than the traditional goal of furnishing an "objective" representation of a world as it might "exist" apart from us and our experience. (pp. xiv-xv, cited in Phillips, 1995, p. 8)

The roots of constructivist ideas in educational studies tend to be revealed in various forms and can be categorized into cognitive constructivism and social constructivism. Cognitive constructivism owns a long-standing heritage beginning from the Kantian tradition which synthesized empiricism and rationalism, with the transcendental categories of time and space which arise in experience (see Phillips, 1995). The Kantian
shift has been so called a ‘Copernicus revolution’ in the history of epistemology in that it clarifies that nature becomes produced only with and through the activity of knowing and not vice versa. When considered as an individual process of the subject, e.g., when representation is regarded as an individual mental apparatus, we can call it cognitive constructivism.

Owing to schema theory in cognitive science, cognitive constructivism does not assume that an actor carries a bunch of information in his head, but rather sets of schema or concepts. Learning is not the quantitative accumulation of information, but a qualitative change of the schema or meaning constructs. In schema theory, the process of internalization does not simply involve transfer of language to individual. Rather, the individual re-organizes and re-constructs experiences with the object through her accommodation and assimilation, as developed in Piaget’s studies of the genetic development of intelligence (see Piaget, 1966, 1971, Piaget & Inhelder, 1974; also see, for introduction of Piaget, DeVries, 1997; Flavell, 1963; Furth, 1980; Youniss & Damon, 1992).

Cognitive constructivism has flourished in developmental psychology. Owing to constructivist presumptions and theories, there emerged a view of childhood from the theories of human development in development psychology. Within child studies, scholars like Piaget were critiquing a form of environmentalism, on the one hand, and biological determinism on the other hand. Against the “blank slate” empiricists of a Lockean or Skinnerian persuasion, they were acknowledging organismic constraints on the ways in which the human beings develop. They deny seeing children as ‘shorter’ or less intelligent adults, and saw development as having qualitatively different stages, each with its own organization and integrity. Along with development of development psychology, the expectation that it would implicate a scientific ground for school teaching has matured (Mischel, 1971; Olsen & Torrance, 1996).

Informed by the related studies of individual construction of meaning, order, and knowledge, how children learn the social world has been discussed as a primary pedagogical maxim. The constructivist understanding of how students understand and act
in their world, in particular along with achievements of the modern scientific studies of child development, provides the pedagogical implications about how pedagogical intentions should be. Whenever constructivist discussions, whatever their theoretical positions are, are re-formulated as reference to pedagogical implications, they appear in familiar praises. As Osborne (1996) notes, child-centered pedagogy is:

\[ \text{Essentially nothing more than a statement of good common sense, and the success of constructivism has come from reminding teachers that children do have ideas and theories and that their thinking is the foundation on which new meanings must be formulated. (p. 65)} \]

On the other hand, a theoretical consideration for constructivism in educational studies also concerns a question of how to embrace the social nature of knowing. In particular, a consideration of cognition colored with individualism, which is also in educational studies, has been treated in relation of a long-standing tension with "socialness" (Phillips, 1995). It has been pointed out that the problem of social interaction brings forth a trouble source for individualists. While individualistic constructivism focuses on isolated minds that construct knowledge from experience in the world, the very point has raised a problem of solipsism. Such a doubt is connected to the question of social conditions of knowledge production, i.e., how meaning is commonly shared with others, in social constructivism. Diverse constructivist discussions comprehend the social nature of knowing in their own perspectives distinctively from each other.

More recently, constructivism has reflected an understanding of the social condition of knowledge production and acquisition in educational studies and explored theoretical models which would embrace them. An example is von Glasersfeld's "radical constructivism." It implicates that knowledge construction is an individual matter of fit between the subject's cognitive structure and the ecological world of his/her experiential environment which also includes various collective traditions of acting and thinking (von Glasersfeld, 1993, 1995, 1996, 1998). He notes that knowing is an organ's coping
strategy to live with external environments. For him, social interaction with others is similar to coping with environmental stimuli. He shows language use as a pure example of it. He notes, a language user’s meanings cannot be anything but “subjective constructs derived from the speaker’s individual experiences” (p. 134). He implicates that learning is a matter of “self-organization” (von Glasersfeld, 1989, p. 136) and knowledge can never be acquired passively. Particularly concerning this point, a Vygotskian perspective has been largely embraced in the current constructivist educational studies and thus will be closely discussed in a later section.

Constructivist claims, once they settled down in educational studies, have coherently provided the basis for a “strong” pedagogical alternative to current formal school practice (see Phillips, 1995). Such a strong policy has supported the innovation-minded discourse. It implicates that teachers cannot assume that all students have the same set of understandings. Instead, it proposes that teachers need to encourage activities from students and they should endow students with more opportunities for this:

When one applies constructivism to the issue of teaching, one must reject the assumption that one can simply pass on information to a set of learners and expect that understanding will result. Communication is a far more complex process than this. When teaching concepts, as a form of communication, the teacher must form an adequate model of the students’ ways of viewing an idea and s/he then must assist the student in restructuring those views to be more adequate from the student’s and from the teacher’s perspective. Constructivism not only emphasizes the essential role of the constructive process, it also allows one to emphasize that we are at least partially able to be aware of those constructions and then to modify them through our conscious reflection on that constructive process. (Confrey, 1990, p. 109, Recite in Phillips, 1995, p.11)
(2) Social constructivism and authentic pedagogy discourse
(2.1) Backgrounds of social constructivism in educational studies

There are enduring efforts to pursue practical knowledge and practical knowing as a curriculum for authentic pedagogy in educational studies. The efforts are persistent in reform discourse such as Open Education, and in Dewey’s progressive education of a century ago, and recently in social constructivist discussion of authentic learning. The interest in the social nature of knowing and learning has been distinctively and systematically progressive in recent discussions of constructivism. In particular, how contextual knowledge works as the content of curriculum has been explored especially in the recently boomed literature of situated learning.

In the recent interest in “situated learning,” which is strongly affiliated with social constructivism, it is not difficult to observe the Deweyan slogan of ‘learning by doing’ (Bredo, 1994; Garrison, 1994, 1995, 1996; Prawat, 1995, 1996 for new interpretations of Dewey’s view of education). This is closely related to the fact that the recent literature of situated learning shares its interest partly with the tradition of American social psychology, including Meadian social psychology and symbolic interactionism which have also been directly or indirectly influenced by Deweyan pragmatism of post-foundationalism (see Chaiklin & Lave, 1993; Star, 1996; Wertsch, 1991 for a review).

For the few last decades, the educational literature has taken it for granted that the content of curriculum, regardless of whether it presents itself in a literal form or in an enacted form, should be within a ‘cognitive domain’ which might be universal and formally rational. In the community of psychologically-oriented educational studies, the program of situated learning urges psychologically oriented researchers to reconsider the social nature of knowing and learning, which promises to bring into view what remained in the shadow of the cognitive approach to teaching and learning (see Anderson, Reder, & Simon, 1996, 1997, Greeno, 1997; Resnick, 1991 for the respective debate). The significance of activities or context in learning which is recurrent in the innovation
discourse is now treated as a topical issue through this literature in educational studies.\(^4\)

Bruner's recent socio-cultural turn, for example, represents such a shift in educational studies. In the 1960s, Bruner had led the educational reform movement under the new instructional model of "discovery learning" in the US. Bruner (1960, 1966) believed children who study well-organized and sequential structures of knowledge in science education could be treated as if they were scientists. He claimed that "[W]hat a scientist does at his desk or in his laboratory, what a literary critic does in reading a poem, are of the same order as what anybody else does when he is engaged in like activities — if he is to achieve understanding" (1960, p. 14). The classroom design of "discovery learning" was treated as a matter of the sequentialization of "knowledge structure" according to a child's developmental stage. His ideas also provided the community of educational studies with a powerful resource whenever instructional innovation was discussed in the Korean community (Shon, 1995 for a respective review). Bruner, who had interests in individual's cognitive development related to collective culture, has since embraced a more socio-cultural position in learning psychology (see Bruner, 1986, 1990, 1996).

Bruner has argued two historical movements that would marginalize 'classical' learning theory. One was the cognitive revolution which was in the 1960s, the other contextual revolution, or, as Bruner has called it, transactionalism. He argued that the two movements in social inquiry of cognition and learning demonstrated the fact that objective reality exists through people making sense of the world, and not in the head, but

\[^4\] Greeno, Collins, & Resnick (1996) articulate the paradigms of educational psychology — behaviorism, cognitivism, and situationalism. They note:

These perspectives are not equally developed, of course. The behaviorist perspective was the main line of development in the psychology of learning for several decades. Development of the cognitive perspective became the major focus of psychological research in learning and thinking in the 1970s. And the situative perspective is still in an early stage of development as an organizing principle and set of work practices for psychological research. (p. 40)
in the social world 'out there.' Bruner's current reformulation of folk psychology (see Bruner, 1996) reflects these two changes in inquiry of human thinking and activity.  

While knowing and learning are reconsidered in terms of practice or activity in educational studies on the one hand, on the other hand “practice” is also a main subject of growing interest in recent social science (Bourdieu, 1977, 1990; Giddens, 1979; Ortner, 1984; Shatzki, 1997; Turner, 1994). ‘Practices’ are discussed through “a large family of

5 Bruner (1996) notes an implication of the recent interest in socio-cultural dimension of thinking and activity in particular regarding education and educational research as follows:

In this [transactionalism] view, a culture is as much a forum for negotiating and renegotiating meaning and for explicating action as it is a set of rules or specifications for action.... Education is (or should be) one of the principal forums for performing this function... It is the forum aspect of a culture that gives its participants a role in constantly making and remaking the culture-an active role as participants rather than as performing spectators who play out their canonical roles according to rule when the appropriate cues occur. (p. 123)

6 In social science, the notion of practice has often been discussed as theoretical construct. For example, Turner (1994) pursues the notion of practice within such a history of social inquiry. Turner points out that our habitual ways of acting tend to trace back to communal sources of knowledge; collective premises, presuppositions, Zeitgeist, discourses, practices, epistemologies, tacit dimension, forms of life, and ontologies. Lynch (1995) reviews Turner’s arguments that social theories of practice take a characteristic form, as follows:

1. Theorists tend to endow their own analyses with an unassailable privilege by postulating tacit sources of agency which remain unrecognized, misrecognized or otherwise unknown to the persons whose actions they control.

2. Collective ‘discourses’ and ‘practices,’ although embodied in particular texts, documents, fleshy gestures and explicit agreements, are always anterior to the more tangible actions which ‘reproduce’ them.

3. Because such hidden collective objects (for example, tacit ‘agreements’ on how to
terms that were used more or less interchangeably with 'practices,'” e.g., tradition, tacit knowledge, Weltanschauung, paradigm, ideology, framework and presupposition (Turner, 1994, p. 2). The family of terms indicates a concept with which social theories could locate the causes that ‘lie behind’ what is brought into view. By this, they take into account what is assumed to be not directly transmitted in what is manifestly known. Usually, the respective studies have criticized the view of socialization or transmission as a central mechanism for the reproduction of social structure or knowledge structure, which is based upon the cultural transmission theory that views the culture as accumulated factual knowledge (see Lave, 1988 for an argument against this viewpoint of culture). Instead, practice theorists share their assumption that everyday practices are a resource of enculturation and “embody within themselves, the fundamental notions of temporal, spatial and social ordering that underlie and organize the [sociocultural] system as a whole” (Ortner, 1984, p. 154).

Along with such a large backdrop in social studies, educational studies have reflected discussions about the nature of knowledge-in use in ways that can be pursued as curricular knowledge. Teaching knowledge in the way it is produced and used has been a primary concern for curriculum administrators and researchers. Such discussions have been influenced by philosophical thinkers such as Oakeshott (1991), Polanyi (1958), Rorty (1980), Ryle (1949), Whitehead (1967, 1978). Their ideas have often slipped into the constructivist discussions, and then have been discussed as theoretical backgrounds against the foundationalist view of knowledge in educational studies (Brownhill, 1983).

For example, in his paper, “Rationalism and Politics,” Oakeshott (1991) makes a distinction between “two sort of knowledge... distinguishable but inseparable” (p.12).
Both sorts, he suggests, are always to be found together in the practical activities of human beings. The first is “technical knowledge.” This is formulated in terms of rules, principles, directions, maxims and the like. They can be put into practice irrespective of time and place as long as people have gotten adequate training in the given procedures.

According to Oakeshott, this is just one constituent of activities. There is also “practical knowledge” which is distinct from technical knowledge. Constrained in time and place, this knowledge “exists only in use, is not reflective and... cannot be formulated in rules” (Oakeshott, 1991, p. 12). According to him, it has to do with “know how” which “defies precise definition and cannot be distilled into a transportable body of teaching. Thus, the only way to acquire it is by apprenticeship to a master” (p. 15).

According to Oakeshott, all activities are marked by the combination of these “two components of knowledge,” the technical and the practical. He argues that “[N]owhere can technical knowledge be separated from practical knowledge, and nowhere can they be considered identical with one another or able to take the place of one another” (p.14). Oakeshott, by this distinction, made a political argument that modern society has become impoverished as a result of neglecting the practical side of human knowledge. He argues that the historical trend, in the name of “reason” and “rationalism,” has been to emphasize and cultivate the technical in the expense of the practical. Instead, he claims that the technical is just an “abridgement” of concrete activity.

The discussion of tacit dimension of knowledge suggested by Polanyi (1958) gives a similar rationale for knowledge-in use. Polanyi has shown through his conceptualization of tacit knowledge that we know more than we can articulate, and how the body is inscribed with skill or know-how. Polanyi (1958) asserts that practical knowing is embodied in action rather than in explicit rule. Thus, he reserves the place of tacit knowledge to clarify an “indeterminacy” between so called ‘formalism,’ e.g., rules, sets of instruction, protocols, formulae, etc. and the practical experience. Whatever Polanyi’s intention is when he suggests a place of tacit knowledge, the argument about tacit knowledge often appears as a model discourse for the authenticity of learning.

The formulation of understanding-in practice is one of the primary concerns of the
modern thought regarding educational theory. Such theoretical discussions about knowledge-in use make it difficult to argue for the separation of cognition and the social world, the form and content of learning, or the learning and its applications. They provide educational studies with a resource to reconsider the curricular knowledge and pedagogical methods. However, it is not until the recent discussions of authentic pedagogy and situated learning, cognition that educators and researchers have gotten more systematic interests in activity methods as better teaching way of the procedural feature of knowledge.

(2.2) Socio-cultural constructivism in Vygotskian activity theory

In particular in educational studies, the notion of the social condition of cognitive development has been developed among neo-Vygotskian activity theorists (see Chaiklin & Lave, 1993; Engestrom, 1995; Kirshner and Whitson, 1997; Resnick, 1989; Resnick, Levine, & Teasley, 1991; Rogoff, 1990; Rogoff & Lave, 1984; Solomon, 1993; Wertsch, 1981, 1985, 1991). Generally, this approach begins with a critique of the separation of studies of cognition from studies of culture (Cole, 1996; Greeno, 1996; Lave, 1988). This approach takes socio-cultural analysis of activity and material condition of knowing and learning. They radicalized a psychological interpretation of Vygotsky’s social origin of mind in terms of activity system which should be influenced by practice theory implicated in the Marxist tradition and literary theory of Bakhtzin. This approach is also parallel to the Meadian perspective of social psychology which was originated through American pragmatism, in that the two try to dissolve individualistic psychological reductionisms in explaining social actions and instead suggested the social construction of individual mind (Kirshner and Whitson, 1997; Wertsch, 1985, 1991).

This approach has built a theoretical model of how individuals learn collective cognition, or "how one constructs the common object." That is, this approach explores a theoretical solution to a question about traditional constructivism. This is also a question about intersubjectivity in social actions. That is, "how can people know the same thing if they are each constructing their knowledge independently? How can social groups
coordinate their actions if each individual is thinking something different?” (Resnick, 1991, pp. 1-2). Overall, its theoretical consideration goes to the ways in which collective “tools,” absorbing historical and material conditions of their use, form and constrain actions and contexts of knowing. “ Appropriation,” in socio-cultural activity theory, is an important alternative to the psychological notion of internalization in functionalist inquiry. Rather, this approach reconceptualizes internalization in order to explicate the social condition of knowing and acting (“interpsychological planes” in their own term) in which tools, whether they are linguistic or material, are adaptively used by the individual (Cole, 1996; Chaiklin & Lave, 1993; Lave & Wenger, 1991; Rogoff, 1990; Rogoff & Lave, 1984; Wertsch, 1985, 1991).

This approach extensively formulates how the appropriation of socio-cultural tools organizes the development of cognition. Rogoff (1990) extends the traditional perspective of development into how the routine social world surrounding a child finds its way to its own pedagogy with which each community’s valued skills constitute the local goals of development. This approach to development of cognition has become much more grounded in the specific tasks and skills, and has grown to include topics such as language, reading, writing, mathematical development which had been considered separate from basic cognitive processes, such as memory and attention.

For example, literacy has become a good example of the levels of relationship between the cognitive skills of the individual, the cultural artifacts employed, and the larger cultural context in which skill with artifacts is practiced. “Practical thinking” (Scribner, 1984, p.13) was used to highlight the culturally organized nature of significant literacy activities and their conceptual kinship to other culturally organized activities involving different technologies and symbol systems. Literacy studies have revealed how literacy has historically profound effects on cognition, has a major role in the cultural technology with which one manipulates cognitive skills (Goody, 1977; Luria, 1971; Olson, 1976; Scribner and Cole, 1981). They have noted that “the special speech styles and cognitive processes involved in decontextualization of mediated means are closely tied to subjects’ participation in schooling” (Wertsch, 1985, p. 217). Then, they have
examined the use of literacy through the studies of historical data, the observation of pre-industrial communities or the mundane social settings outside of school.

Similarly, mathematical knowledge has been studied in the practical settings of its use. For instance, Scribner (1984) explicates the use of mathematics knowledge by dairy workers who assemble, price orders and take inventory in the warehouse. She describes how arithmetic procedures used in the dairy are constrained and aided by the arrangements of order sheets and the cases of dairy items to be counted. Rather than operating by symbols, Scribner's workers got reliable arithmetic results by treating the materials of case size and physical space they were working with as part of their calculation process. Lave, Murtaugh & de la Rocha (1984) similarly observed that arithmetic use in shopping is structured by the practical problems to be solved. Newman, Griffin & Cole (1984) focus on the influence of the experimenter on the subject's performance in laboratory situations. They clarify how the instructions to the subject's performance cannot be separated from the assessment of performance.7

Along with increasing interest in the role of practical actions and context in cognitive

7 Following Light and Perret-Clermont's study (1989), Rogoff (1990) criticizes that the concept of conservation in Piaget does reveal not only the child's personal knowledge of physico-mathematic structure but also outcomes of the experimental situation. The concept of conservation in Piagetian scheme was devised to articulate the demarcation of stages between concrete and abstract. The experiment demonstrates that a child under the stage of abstract fails to tell the amount of the content of water from the size of the cup which holds it. She points out that young children's confusion in Piagetian task may be "not so much conservational as conversational" (Light and Perret-Clermont, 1989, p. 103). For in the course of the experiment, the experimenter's conservation question of whether the amounts of material have changed or remained the same is not a straightforward request for information. Rogoff argues that while the development of cognition is culturally specific, the practice of guided participation is universal (Also see, for the discussion of ecological validity of experimental study, Bronfenbrenner, 1979; Cole, 1988; Cole, Gay, Glick, & Sharp, 1971; Goodnow, 1976; Neisser, 1976; Siegal, 1991).
development within specific areas, activity theory postulates, as a general theoretical model to explicate a possible condition for “appropriation,” a virtual realm of the intersection of the individual domain and the social one; i.e., “the zone of proximal development.” This conceptualization was originated by Vygotsky, a Russian social psychologist in the early 1900s. According to Vygotsky (1978), the zone of proximal development refers to:

the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (p. 86)

Later, activity theorists have expanded the assumption of ZPD from the Vygotskian scheme in which ZPD assumes to be located in the web of higher order of reasoning (Leont'ev, 1981; Newman, Griffin & Cole, 1989; Rogoff and Wertsch, 1984). For example, Engestrom (1987) extends the assumption of the zone of proximal development as the distance between the everyday actions of individuals and the historically new form of the societal activity that can be collectively generated as a solution of everyday problem. According to this notion, pedagogy is enacted not in the master’s intention, but in the organized nature of everyday practice in which apprentices get engaged. The “scaffolding” metaphor (Wood, Bruner, and Ross, 1976) shows this case, meaning that adults could become an ecological intervention in children’s appropriate handling of a task, and thus the interruption in novices’ activity by the expert could be possible in that zone. The notion of ZPD, in this way, provides a theoretical model with which researchers can consider the relationship between agent and society.

This model has been devised to explicate a condition for appropriation of collective tools including semiotic tools. The notion that human action is “tool-mediated” shows this assumption as an interiorized form of language, i.e., “semiotic mediation” or “dialogicality” following Bakhtin (1981). Wertsch (1985) notes this: “[O]nce semiotic mediation is incorporated into practical action, the action undergoes a qualitative
Within such a perspective, the outside world does no more trouble for explicating individual cognition as in the traditional constructivist discussions. Rather, this perspective takes social world as a necessary condition of development of individual cognition. For instance, Newman, Griffin, & Cole (1989) note this concern:

An object, such as a poem, a chart or a spoken concept may be understood very differently by the child and the teacher.... But these differences need not cause “trouble” for the teacher or the child or the social interaction; the participants can act as if their understandings are the same. At first, this systematic vagueness...may appear to make cognitive analysis impossible. However, it now appears that this looseness is just what is needed to allow change to happen when people with differing analyses interact. (Newman, Griffin, & Cole, 1989, p. 62)

In this way, theoretical explication of the social nature of cognition and learning postulates a rational model with which we could view actual phenomena. This approach identifies social action and interaction as engine of the more local realm of individual’s cognitive development, i.e., “microgenesis” of knowledge in their own term (Wertsch, 1991). As implicated in Vygotsky’s (1956) dictum that “instruction creates a zone of proximal development” (p. 450), such a rational model has provided a teaching model for researchers who are exploring better teaching method, that is, a model which clarifies a possible condition of social intervention to help an individual’s construction of cognition. Brown et al. (1989) argue that “it is a mistake to think that important discourse in

---

8 Vygotskian theorists advise theoretical constructs, “genetic domains,” in order to examine the development of the individual (ontogenesis). According to Wertsch (1985), these domains include phylogenesis, sociocultural history, and “microgenesis.” Amongst, microgenesis indicates the short-term formation of a psychological process. He refers to this concept in, for example, what the investigators could observe, from their subjects, when conducting laboratory studies; e.g., subjects’ repeated trials in a task setting.
learning is always direct and declarative” (p. 40). Rather, this approach has revised the relationship between teaching and learning as collaborative social interaction, guided instruction, joint construction of meaning, or social construction of knowledge. However, a question here remains, regarding how is this not “directive and declarative”?

(2.3) Situated learning theory and discourse of authentic pedagogy

Influenced by Vygotskian activity theory, a consideration of the social nature of learning has been diversely and more systematically treated in the recent discussions of constructivism in educational literature. Above all, “situated cognition,” or “situated learning” theory has led the current mainstream constructivist discussions in educational studies. Based upon the recent development of discussions of social constructivism, situated pedagogy theory develops the idea that what is learned should be inseparable from how it is learned and used. The point of the claim is that knowledge, order and meaning are products of the activity, context, and culture in which they are developed and used. Brown et al. (1989), in their seminal paper “Situated cognition and the culture of learning,” claim:

For centuries, the epistemology that has guided educational practice has concentrated primarily on conceptual representation... (as) prior to all else. A theory of situated cognition suggests that activity and perception are importantly and epistemologically prior [to conceptual representation]... and it is on them that more attention needs to be focused... (T)he unheralded importance of activity and enculturation to learning suggests that much common educational practice is the victim of an inadequate epistemology. (1989, p. 41)

They explicate activity and context as a source of knowledge through an analogy of tool use. Tools can be only be fully understandable through use rather than through abstract concepts about them, and using them entails both changing the user’s view of the world and engaging in the tradition of knowledge-in-use. Tool use, including the use of concepts, is the same as the case of language use. They note that “knowledge indexes the
situation in which it arises and is used...which becomes coded by and connected to the activity and environment in which it is developed" (Brown et al., 1989, p. 36).

Interwoven with our activity, the characteristics of the situation are immediately available to the user or actor. This is observable in the fact that indexical terms are virtually transparent. Brown et al. (1989) describe the mundane world as a source to structure coherent intelligible activity. They assert that “[r]ecurring features of the environment may thus afford recurrent sequences of actions” (p. 37). That is, the structure of cognition is not confined to what is contained in the individual’s brain, but distributed across the environment. In this way, knowing and learning are essentially situated. They formulate:

[T]he activity and context in which learning takes place are regarded as merely ancillary to learning - pedagogically useful, of course, but fundamentally distinct and even neutral with respect to what is learned..., however, the activity in which knowledge is developed and deployed, it is now argued, is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity. Learning and cognition, it is now possible to argue, are fundamentally situated. (p. 32)

Such assumptions and ideas in situated learning theory have been stimulated in the recent investigations of the practical nature of thinking and action. One of the impacts on such formulations can be seen in the socio-cultural approach to “practical thinking” which has given new insight to studies of problem-solving. For instance, Lave (1988) presents a critique of the “culture of transmission.” Traditional cognitive studies have assumed that knowledge must be like a ‘substance’ that is acquired during learning and later moved to a new situation where it either is or is not used (see Tuma & Reif, 1980 for the relevant discussions). It implicates that knowledge is an isolated entity and each context of activity exists separately. According to this approach, problem solving is assumed to be the ideal model for the cognitive procedures employed to solve questions
of fact in the service of goals exogenous to the process under study. Here, the concept of "goals" is regarded merely the ends of the "problem solving procedures."

As a result, while transfer experiment treats knowledge as a chunk of information, it does not require the account of contexts. According to her, the assumption of the work of "pure" reasoning comes from the decontextualization of the respective practice by which local context was stripped out, as if it were in a lab experiment. Through descriptive examinations of natural settings instead of preorganized labs, she has demonstrated that problem solving is a work of knowledge at hand using local context artifacts and thus transformed into those. Problem solving, according to such a critique, is situated in ongoing actions. Brown et al. (1989) note:

Instead of taking problems out of the context of their creation and providing them with an extraneous framework, JPFs [Just Plain Folks] seem particularly adept at solving them within the framework of the context that produced them. This allows JPFs to share the burdens of both defining and solving the problem with the task environment as they respond in "real time." The adequacy of the solution they reach becomes apparent in relation to the role it must play in allowing activity to continue. (1989, p. 36)

For example, Lave (1988), in her American Weight Watchers study, explores the members' activities of the dieting program as they incorporated new measurement practices into meal preparation. In this case, the dieter was supposed to measure three quarters of the two-thirds cup the programme prescribed. With some deliberation, but without the literal calculation (e.g., 2/3 x 3/4 = 1/2), "(H)e filled a measuring-cup two-thirds full of cottage cheese, dumped it out on the cutting board, patted it into a circle, marked a cross on it, scooped away one quadrant, and served the rest" (p. 165). Showing how the material of cottage cheese is used as a tool and simultaneously the ends in the course of actions, this study shows how arithmetic reasoning and manipulating material cannot be separated in the process. The procedure in which a problem arrives at its solution is not linear in actual situations. They do not separately occur but are available
in context altogether. In this way, she shows that problem and solution never leave the circumstantial context where they arise.

The achievements of the studies on practical reasoning in everyday settings out of school, along with the theoretical consideration of the nature of knowing, provide an opportunity to reflect on the current culture of school practice (Bentley, 1998; Resnick, 1989). The explication of the social nature of knowing on actual occasions re-constructs our understanding of how thinking and meaning are shaped in the actual world, and provides researchers and educators with a model of what school learning could be. Whenever studies of situated learning try to pursue the ideal of better classroom practices, the effort begins with a critique of current school practices as based upon “the culture of acquisition,” by which Lave (1990) refers to a set of beliefs that culture is something to be acquired. According to her, such a decontextualized view of learning is really a part of the contemporary culture in which the school system reproduce itself as well as partly social relationships out of school. She illustrates how decontextualized methods in school learning produce not so much the very practice of the social world of professional works as deformed practices of it. She argues that while school and curriculum make the content to be learned explicit and specific, children improvise on the production of that practice, but they seldom improvise the practice itself.

As a crucial resource to reflect the contemporary condition of public schooling, the theoretical consideration of the social nature of knowing in everyday settings has joined the educational literature, and offers insights into classroom instruction. It supports the constructivist view of the social features of knowing such as practice, interaction and context as an engine for individual cognitive development. In particular, the discussion of “authentic” activities leads to explorations for innovative models. One of the resources for authenticity design models can be observed in the assumption of the community of practice (Brown, Collins and Newman, 1989; Lave and Wenger, 1991; Resnick, 1989). The idea is that learning a tool includes not only how to use a tool but also engagement in the larger context, e.g., a cultural context of the community of the respective practitioners. Brown et al. (1989) argue that coherent, meaningful, and purposeful
activities available to members in the community of practice are “authentic activities” within the ordinary practices of the culture. In this perspective, Brown et al. (1989) argue that school teaches less robust knowledge, i.e., knowledge that is not grounded, or authentic, within the culture of the respective community of practice. Brown et al. go on to argue, from the perspective of authentic practice, that classroom tasks and school culture are different from what authentic practitioners of math, science or history do. According to them, classroom tasks fail to provide the contextual features that allow authentic activity.

Their argument develops the reform idea of how school knowledge and learning could be linked more effectively to the larger social world out of school. This approach views a redesign of school classrooms as a simulation of the community of practitioners who actively communicate about and engage in the skills involved in expertise, where expertise is understood as the practice of solving problems and carrying out tasks in a domain. Collins (1994) formulates the authenticity principle that “knowledge, skills, and attitudes should be embedded in tasks and settings that reflect the uses of these competencies in the world....the authenticity of the learning environment ensures that the knowledge gained will be readily available in the kinds of situations they will face in their [users] work” (p. 30). Such a principle is iterated in studies that recommend constructivist exercise as professional programs for classroom teaching (Collins, Brown & Newman; 1989; Duffy & Jonassen, 1992; Jonassen & Land, 2000; Newman, Griffin, & Cole, 1989; the cognition and technology group at Vanderbilt, 1990; Wertsch, 1991).
3. Authentic science education and constructivism

The goals of instructional innovation are also coherently visible in classroom science. With the address of Open Education, the 7th Korean national curriculum in science education embraces an “STS” (science-technology-society) model. “STS” has been developed as an alternative to discipline based curriculum in Western society, and was then introduced to the Korean science curriculum in the 1980s. With this, the relationship between science and socio-cultural context has been brought into focus as an educational goal. Generally speaking, this movement has emphasized the practical application of knowledge, social-problem centered science education, decision making process about science and technology in everyday life, and citizen education for all students rather than elite education. The National Guidance of Curriculum (1999) indicates the general direction of instruction in elementary science education as follows:

1. To elicit and utilize open questioning.
2. To teach fundamental inquiry process (observation, classification, measurement, anticipation, reasoning, etc.).
3. To encourage cooperative learning through group activities
4. To encourage student centered discussion.
5. To provide information about science such as science articles in newspapers, biographies of scientists, etc.

With this general direction for classroom science, the intention to engage students in authentic tasks is evident. Specifically, the guidelines of the 7th National Curriculum indicate the direction with which experiment activities in classrooms should be implemented as follows:
1. Acknowledge what experiments are about. Otherwise, students could improve the competency to manage tools, but would fail to develop scientific attitude which would require inquiry ability.

2. Experimental activities would facilitate scientific attitudes in students. For this, the teacher should not reveal the outcomes before performing experiments.

3. Experiments should be simple and materials and tools easy to work with.

4. Encourage students to perform various ways of experiments.

5. Discourage students from making hasty conclusion.

The efforts to pursue disciplinary culture as an authentic model of school learning are distinctive in science education. Teaching to scientifically see, hear and think would be what science educators pursue as aims of science education. Science education has taken as an authentic model an extended process in which scientists actively construct representations by employing problem-solving procedures. For example, discovery learning is recommended as the most authentic teaching model in science education. Such a claim is not only seen in the recent instructional innovation discourse, but also earlier in science education, a century ago:

Heuristic methods of teaching are methods which involve our placing students as far as possible in the attitude of the discoverer — methods which involve their finding out, instead of being merely told about things. It should not be necessary to justify such a policy in education.... Discovery and invention are divine prerogatives, in some degree granted to all, meet for daily usage... it is consequently of importance that we be taught the rules of the game of discovery and learn to play it skillfully. The value of mere knowledge is immensely over-rated, and its possession over-praised and over-rewarded. (Armstrong, 1898, in Atkinson & Delamont, 1976, p. 88)

This is an enduring interest concerning school science learning, whatever the supportive theories and claims are. In pursuing such interest, we find some reason that
there is prevailing beliefs that the scientific tradition has prompted rationality, critical thinking and objectivity, and thus science subject matter has been a topic by curriculum theorists; e.g., claims for the structure of knowledge (Bruner, 1960, 1966; Schwab, 1962, 1978), critical consciousness (Apple, 1992; Kincheloe, 1998; Siegel, 1989, 1997; Young, 1992), critical constructivism (Larochelle, Bednarz, & Garrison, 1998) or Deweyan perspective on science education (Dewey, 1916/1945; Wong et al., 2001). Even though each claim and theory reflects its understanding of knowing and activity, regardless of when and where it is issued, there is a persistent discourse for instructional reform and authentic curricula. McDermott & Webber (1998) called such a recurrent interest “an old format for new stories” in organizing the reform of classroom education. They articulate it as follows:

I. The content is defined as sometimes difficult and sometimes not, but always functional;
II. Access is attained situationally and is ultimately available to anyone who hangs around long enough; and
III. Teaching demands designing problems that model the real world and invite mastery as an outcome of participation. (p. 331)

(1) Constructivist discourse in science education

In the last decade, the Western literature in science education has taken a very strong turn toward analytic constructivism and an appreciation for the social character of science instruction (see Duit & Treagust, 1998; Duschl & Hamilton, 1992; Geelen, 1997; Kelly, Carlsen, & Cunningham, 1993; Matthews; 1991; Miller, 1989; Tobin, 1993). The literature has been informed by contemporary understandings of scientists’ production of knowledge and work. Increasingly allured by the analytic accomplishments of the philosophy of science and social studies of science, researchers in science education have tried to reflect renewed understandings of “authentic science” for the more authentic model of classroom science practices. Constructivism, whatever the positions are among the wide range of constructivist discussions, now functions as “a referent for reforming
These studies parallel an increased interest in social constructivism in the general educational literature, and they highlight the idea that practices in the science classroom have more to do with engaging students in the processes of social organization than with formalized rational orders of inquiry (Cobb, Wood, & Yackel, 1991; Driver, Asoko, Leach, Mortimer, & Scott, 1994; Kelly, Carlsen, & Cunningham, 1993; McGinn & Roth, 1999; Roth & McGinn, 1998a, 1998b).

Constructivist claims have been increasingly popularized in science education in the last decade and they agree that scientific knowledge is not just about the phenomena of nature, but constructs that are advanced by the scientific community to interpret nature. Constructivist discussions bring into view scientific inquiry as meaning-making and emphasize the role of the agent or a community of practices. Driver et al. (1994) address the essential claim which signals a constructivist position in science education as follows: "The core commitment of a constructivist position, that knowledge is not transmitted directly from one knower to another, but is actively built up by the learner, is shared by a wide range of different research traditions relating to science education" (Driver et al. 1994, p. 5). The role of science education is to mediate scientific knowledge for learners and to help them to make sense of the ways in which knowledge claims are generated and validated, rather than to organize individual sense-making about the natural world. It is suggested that this perspective on pedagogy, therefore, differs fundamentally from an empiricist perspective which focuses on naive induction as inquiry into the objects of nature.

While many scholars and educational reformers recognize that the nineteenth-century positivistic philosophy of science is an inadequate foundation for the science curriculum, they also expect that new understandings of science will impact on science curriculum and its teaching methods. Some assume that inadequate attention to philosophy of science may have been partially responsible for the failure of the 1960s reform movement in US science education (Duschl, 1985). Above all, constructivist notions of science learning have reflected the efforts to explore the logic of the growth of scientific theory over the last few decades, in order to be informed about the nature of scientific inquiry.
The traditional view of science had claimed that the inquiry of the context of development should be based upon justification of knowledge claims rather than the discovery context of them. According to this view, scientific discovery is comprehended as processes of rational thinking, owing to its idealized interpretation of what actually happens in the scientific enterprise. This approach views science as accumulated sets of knowledge or well-established procedure, relying on the abstract discussions of scientific method. The current view in science education emerges from the constructivist approach to scientific progress (Woolgar, 1988). Such an approach claims that the growth of scientific knowledge is not a cumulative process resulted from the findings of the nature but revisionary within communities of scholars, yielding revolutionary changes in dominant paradigms by new approaches to problems found anomalous within current conceptions (Feyerabend, 1975; Hanson, 1958; Kuhn, 1962; Lakatos, 1970; Polanyi, 1958; Toulmin, 1953, 1961).

In a popular model in school science, “discovery learning” is devised for classroom students to “re”experience the process of knowledge production (Petrie, 1981 for a review). In cognitively oriented constructivist claims, discovery learning is not a matter of discovering what the natural world has to reveal, but what is created by people making

---

9 In fact, the assumption of ready made science has been long-standing in science education studies. This conventional view in science education has implicated that school science is a ‘second production,’ in that the subject matter of school science might also consist of “ready-made-science.” Hawkins & Pea (1987) formulate such a problematic as follows: “Science education tends to present science as a body of knowledge composed of established facts and methods” (p. 298). As a disciplinary subject matter, the idea of a distinctive knowledge structure in science curriculum prevails, so it is believed that “each discipline provides a distinct set of concepts, criteria of rationality, dispositions, interests, values, etc., each different from those of everyday life, that allows us to organize and structure experience in unique ways” (p. 32). In earlier instructional innovation efforts in the 1960s, the idea of structure of knowledge was suggested as a strong resource for learning transfer (Schwab, 1964). For example, Bruner (1960) has argued that “in order for a person to be able to recognize the applicability or inapplicability of an idea to a new situation and to broaden his learning thereby, he must have clearly in mind the general nature of the phenomenon with which he is dealing” (p. 18).
sense of their observations. This is a profound assumption of individual constructivism, which reflects its own understanding of the science enterprise, and suggests a theoretical model of how an individual would produce scientific knowledge. In simulating the practices of expert scientists for classroom purposes, educational designers reflect understandings of what a scientist is "really doing." According to cognitive constructivist view of learning, children’s ideas and understandings prior to instruction are not in an atheoretical state, and may crucially facilitate or obstruct further learning (Anderson & Smith, 1986; Finley, 1983; Krupa et al., 1985; Linn, 1986; Novak, 1977; Novak & Gowin, 1984; Resnick, 1983). Such a view has found such a model in a theoretical assumption that an individual constructs a representation of the nature, whether he is an expert or a novice. This idea is very prevalent in constructivist discourse in science education. Concerning such a point, von Glasersfeld (1989) explicates “constructivist science teacher” as follows:

Recent developments in the philosophy of science have provided more adequate way of thinking about how scientists proceed to devise better ways of ‘coping’ with the world of our experience; it should not be surprising that this analysis is applicable also to the process of education. Students may not have the same particular goals that scientists try to attain. But, unless we assume that they share, with the inventors and developers of the conceptual models we call science, the goal of constructing a relatively reliable and coherent model of the individual experiential worlds, we cannot lead them to expand their understanding. Memorizing facts and training in rote procedures cannot achieve this. (p. 138)

Such a theoretical consideration of scientific knowledge (re)production leads to a rational model of science learning. This is a distinctive feature of the prolific and influential literature in science education on the “conceptual change” model of learning (see Carey, 1985; Chinn & Brewer, 1993; Hawkins & Pea, 1987; McCloskey, 1983; Posner, Strike & Hewson, 1982; Vosniadou & Brewer, 1987; West & Pines, 1985). As it has often been referred, conceptual change is “the most significant idea the recent
philosophy of science contributes to science education” (Duschl et al., 1992, p. 25). This approach portrays students’ learning in science as reflecting similar patterns of change as have occurred in science itself, through progressive restructuring of students’ underlying theories. Vosniadou & Brewer (1987) explicate the idea more closely in terms of the differences between novices and experts in specific domains of expertise. They claim that science learning requires the novice/expert shift, which entails a “radical restructuring.” It is assumed to resemble Piaget’s notion of accommodation between different two schema or paradigm conversion between normal science and revolutionary science for Kuhnian scheme. It assumes that scientific thinking does not grow out of efforts to test or substantiate certain beliefs but out of trying to show how a revised theory is an improvement over its predecessor. This idea tends to be dominant in science education studies. Nersessian (1991), for example, argues that:

... the processes of constructing a scientific representation are the same for scientists and students of science. That is, the cognitive dimension of the two processes is fundamentally

---

10 Posner, Strike, Hewson & Gertzog (1982) develop the idea of conceptual change as a systematic teaching model in science education. The idea, informed by epistemological literature and cognitive psychology, is that children’s existing conceptions about natural phenomena is a starting point to teach science. This has to do with, in particular, the notion of accommodation in Piaget’s term. Thus, the essential feature of the model is to clarify the conditions of accommodation. The question goes on; under what conditions does one central concept come to be replaced by the other? In this model, instruction is regarded as providing a rational basis for conceptual change. The model suggests the following four conditions:

1. There must be dissatisfaction with existing conceptions.
2. A new conception must be intelligible.
4. A new conception should suggest the possibility of a fruitful research program.
the same... [T]he working hypothesis of this paper is that there should be a single cognitive model for conceptual change in science and in learning science. (pp. 134-135)

Constructivist notions implicate that teaching science involves negotiation and transformation, rather than transmission. That is, it suggests that teaching should elicit students’ ideas at the outset and then make use of classroom experiences to transform them, by encouraging children to articulate their ideas more clearly to identify contradictions or by challenging children’s ideas using empirical counterexamples. It suggests that the science view that the teacher is presenting should be in conflict with learner’s prior knowledge schemes. The program of conceptual change is frequently demonstrated in studies which pursue instructional design as planning for a conflict between students’ everyday conceptions of the world and accepted scientific concepts and guiding its resolution. This idea is very common, and the following statement reflects it:

We hypothesize that children start by adopting the “common sense” view that the earth is flat and motionless and that gravity operates along an up/down gradient. This view is consistent with children’s phenomenal experience but conflicts with current scientific theories. (Vosniadou & Brewer, 1987, p. 58)

‘Breaking with everyday experience’ in the conflict between the student’s prior knowledge drawn from everyday experience and what is taught in science classroom might then be a maxim for the science teacher. This assumption consistently recurs in considering teaching science more authentically. In particular, social constructivist discussions in science education embrace such an assumption in somewhat different ways, and provide more plausible rationale for it in some sense.

(2) Social constructivist discourse and authentic science pedagogy

Social constructivist ideas have gained growing attention in science education in recent years, and have brought into view the social nature of science and science learning.
These studies parallel an increased interest in social constructivism such as situated learning theory or the Vygotskian perspective in the general education literature. This approach highlights the idea that practices in the science classroom have more to do with engaging students in the immersion in the language and activities of the community of scientific practices, i.e., some of norms and practices that are deemed to be characteristic of scientific communities, rather than discovering of nature (Cobb, Wood & Yackel, 1991; Cunningham & Helms, 1998; Driver, Asoko, Leach, Mortimer & Scott, 1994; Kelly, Carlsen & Cunningham, 1993; McGinn & Roth, 1999; Roth & McGinn, 1998a, 1998b). Driver et al. (1994) formulate social constructivist notion of science as follows: "...scientific knowledge is a symbolic and socially negotiated. The objects of science are not phenomena of nature but constructs that are advanced by the scientific community to interpret nature" (p. 5). These studies have begun to consider how classroom science could be constructed through contextual activities of engagement in material, discursive and environmental arrays, rather than through transmission of an abstract knowledge structure.

Constructivism has provided fruitful explanations for science education. Both individual and social constructivism have been developed upon backdrops of heterogeneous theoretical assumptions and issues. Social constructivism has pointed to the limits of individualistic cognitive constructivist theories and assumptions. However, a theoretical consideration of the science learning situation has embraced both individual and social discourses on the construction of knowledge, and each suggests a theoretical model about how a ‘constructivist’ teacher should organize his lesson time. Such a model implicates the role of teacher as a mediator between the cultural tools and learner’s individual meaning making. It recommends that a teacher make “the cultural tools of science available to learners and supports their (re)construction of the ideas through discourse about shared physical events” (Driver, et al., 1994, p. 11).
(2.1) Authentic science pedagogy and new understanding of science in social studies of science

In particular, social constructivist understandings of science have impacted on change of the viewpoint of science in science education. Against the conventional view in science education, recent scholarly endeavors introduce the newer understanding of authenticity of science in order to elevate science education into more authentic one. Along with such a concern, new understanding of the scientific enterprise has been embraced as a resource with which one can consider more authentic way to teach science. Here, recent studies of science refer to an understanding of science which has arisen from scholarly endeavors in the history, philosophy and sociology of science (SSK). These studies of science suggest new understandings of science, i.e., what scientists "really do" in their labs or workplaces (see Collins, 1985; Knorr-Cetina & Woolgar, 1983; Latour & Woolgar, 1979; Lynch, 1985, 1993; Lynch & Woolgar, 1990; Pickering, 1992; Woolgar, 1988). These studies have observed that any perceived demarcation between scientific knowledge and everyday knowledge is based upon a cultural view of science, rather than upon occasions of science as practiced in the real world. Instead, these studies have illustrated that scientific research and products are occasioned achievements embedded in the ordinary practices of their local settings.

Among the SSK literature, the "strong program" emerged in Britain in the 1970s, and is the most widely recognized program of studies (Barnes, 1974, 1982; Bloor, 1976). It is formulated against the earlier established sociology of science implemented by Mertonian social studies of science. Mertonian sociology of science in the early 1940s proposed norms which characterize science as preserving its own autonomy from social context. It was devised to secure "the universal social conditioning of knowledge" (Knorr-Cetina

---

11 The outcomes of social studies of scientific knowledge are so heterogeneous that there is no single coherent account of the works in the science community. "Social studies of scientific knowledge" (SSK) is a shorthand way of referring to various lines of relativist, constructivist, and discourse analysis research (see Lynch, 1993, for the discussion).
and Mulkey, 1983). Instead, SSK has argued for the rejection of the Mertonian norms of universalism, communism, disinterestness and organized skepticism which are assumed to constitute science.\(^\text{12}\)

Above all, such a question became possible for SSK as it extended its topics from the "new philosophy of science" in the 1960s and the 1970s (Feyerabend, 1975; Hanson, For instance, Bloor (1976), through his claim of the strong program, initiated his social constructivist explanation of scientific knowledge: "Can the sociology of knowledge investigate and explain the very contents and nature of scientific knowledge?" (p. 1). The Mertonian program has remained silent on the question which Mannheim, one of founders of earlier sociology of knowledge, had raised, and is still current: Are social processes of innovation "to be regarded merely as conditioning the origin or factual development of ideas (i.e., are they of merely generic relevance), or do they penetrate into the 'perspective' of concrete particular assertions?" (Lynch, 1993, p. 102). Suggesting a strong program, Bloor (1976) tried to explain the "very content and nature of scientific knowledge." Far from the Mertonian program, SSK proposed to examine scientific work and the knowledge it produces, as a social process. Bloor proposed four tenets for such a program:

1. It would be causal, that is, concerned with the conditions that bring about belief or states of knowledge. Naturally, there will be other types of causes apart from social ones that will cooperate in bringing about belief.
2. It would be impartial with respect to truth and falsify, rationality or irrationality, success or failure. Both sides of these dichotomies will require explanation.
3. It would be symmetrical in its style of explanation. The same types of cause would explain, say, true and false beliefs.
4. It would be reflexive. In principle, its patterns of explanation would have to be applicable to sociology itself. Like the requirement of symmetry, this is a response to the need to seek for general explanations. It is an obvious requirement of principle, because otherwise sociology would be a standing refutation of its own theories. (1976, pp. 4-5)
1958; Kuhn, 1962; Polanyi, 1958; Popper, 1959; Toulmin, 1953, 1961, 1972). Arguing against logical empiricism, which had been the mainstream explication of science in those days, it had developed a new understanding of science. Logical empiricists had assumed that science might be represented as a unique method, which then could be reduced to a set of methodological rules for formulating and testing factual propositions. While logical empiricists focused on a formal analysis of the structure of scientific outcomes, the analysis of science as a cultural-historical process in this new approach brought into view the process in which the outcomes are produced.

Kuhn's well-known work (1962), The structure of scientific revolution, had stimulated SSK to turn the topics of the traditional philosophy of science into the sociological domain. Kuhn, through his historiography of scientific discovery, discussed how the demarcation criteria between science and non-science could be a retrospective illusion, through which those criteria explain only those events that gave rise to them. His argument could be clearly seen in his critique of Popper's (1959) logic of falsification, which was a promising alternative explication of logical empiricist's formal logic concerning scientific discovery. Kuhn (1970) criticized the Popperian logic of falsification in that Popper still preserve the empirical viewpoint of the growth of scientific knowledge.

The social-historical turn to understand scientific enterprise has provided some leverage for SSK to pursue novel understanding of science. It has to do with both the thesis of the underdetermination of scientific theories by the evidence, and the thesis of the theory-ladenness of observation. The former asserts any theory can be maintained in

---

13 Lynch has suggested 6 theses deriving from the philosophical and historical studies of science: (1) the disunity of science (Feyerabend, 1975; Galison and Stump, 1996) (2) the problematic features of experimental replication (Popper, 1959) (3) the theory-ladenness of observation (Hanson, 1958) (4) the underdetermination of theory choice by experimental evidence (Quine, 1980) (5) the intertwining of scientific with commonsense reasoning (Polanyi, 1958) and (6) the discrepancy between practice and retrospective accounts of practice (Kuhn, 1962).
the face of any evidence, provided that we make sufficient adjustments in our beliefs (Quine, 1980). This means various factors such as social, economical, political, aesthetic, etc. are put into a determination of scientific fact. The latter implies that observations are theory-impregnated in the sense that what counts as relevant and proper evidence is determined by the theoretical paradigm which the evidence is supposed to test (Hanson, 1958). Theory-ladenness is the other side of the underdetermination coin, and together lend support to SSK inquiries which do not exempt knowledge production in the natural science from social science investigation.

SSK gives us a reason to doubt the traditional division between the Geisteswissenshaft and Naturewissenshaften, whereby it is assumed that natural science directly observes a pre-given nature while social science must treat symbolic orders constructed by human beings. SSK literature has popularized, as Woolgar (1988) named it, the 'enculturation model' of science. By this, he means science itself would have to do with complex social situations including lab equipment, technologies, workers in the lab and their skills, journals, documents, etc. Well-organized documents, final reports, highly formalized formula on nature and reality are heterogeneous-products, rather than logical products of scientific activities. Thus, Lynch (1999) claims that all sciences are human sciences in the sense that “facts and natural laws depend on organized courses of practical and communicative action” (p. 489).  

SSK studies of laboratory life claim a postulation of a unified scientific method does not describe what scientists actually do in their laboratories. This approach shows that a scientist at work is a “bricoleur” who looks over the materials at hand and improvises a

---

14 For instance, Lynch (1999) notes the striking similarity between the research artifacts of interest to biologists and the historical artifacts unearthed by archaeologists. He points out the fact that in both cases artifacts are material residues that bear the traces of a hidden culture. In the former case, artifacts are the “negative discoveries of the traces of more immediate origin,” while in the latter they are the “positive discoveries of the traces of ancient culture” (p. 224).
This area of research has demonstrated that the reasoning of scientists is characterized by its local nature, depending on the research context (Knorr-Cetina, 1981; Latour and Woolgar, 1979). Knorr-Cetina (1981) notes that "[T]he contingency and contextuality of scientific action demonstrates that the products of science are hybrids which bear the mark of the very indexical logic which characterizes their production, and are not the outgrowth of some special scientific rationality to be contrasted with the rationality of social interaction" (p. 33). This approach makes us aware that scientific work is no more than mundane work and vernacular competence, even though it does not mean that all mundane work could be scientific.

Stimulated by such a new understanding of science, recent literature in science education has explored authenticity in science education, and developed models and curricula organization. In order to transplant this new understanding of scientific practice, innumerable catalogues which articulate the respective disciplinary culture would be needed. For example, McGinn and Roth's (1999) paper, Preparing students for competent scientific practice: Implications of recent research in science and technology

The notion of the engineer who had supposedly broken with all forms of bricoleur is therefore a theological idea: and since Levi-Strauss tells us elsewhere that bricolage is mythopoetic, the odds are that the engineer is a myth produced by the bricoleur. From the moment that we cease to believe in such an engineer and in a discourse breaking with the received historical discourse, as soon as it is admitted that every finite discourse is bound by a certain bricolage and that the engineer and the scientist are also species of bricoleurs then the very idea of bricolage is menaced and the difference in which it took on its meaning decomposes. (p.256)
studies, demonstrates what such a catalogue of curricula in authentic practices would look like. First, there is constructing “actor’s network.” The practice of the science community is no less than a nexus of trajectories or webs of social relations between agents, tools, materials, instruments. In this way, communities of the school classroom are assumed to simulate connections to such a network (see Driver, et al., 1994; Garrison & Bentley, 1990; Hawkins & Pea, 1987).

Second, consider manipulating “inscriptions.” The accumulation and transportation of science experience is possible through inscribed devices, such as visual artifacts, e.g., photographs, X-rays, data tables, graphs, equations, maps, diagrams, models and hybrids of these forms. Most parts of scientific work consist of the production of such devices. Authentic classroom science is supposed to encourage to use various artifacts of technology (see Cajas, 1999; Lemke, 1997; Roth & MaGinn, 1998a, 1998b; Walkerdine, 1997). Third, simulating members’ discourse of community of science. Science knowledge is constructed by its discursive process, rather than being related to nature. Educators should install conditions for students to increase opportunities to participate public science-related discourses (see Cobb, Wood & Yackel, 1991; Driver, Asoko, Leach, Klaassen & Lijnse, 1996; Edwards & Mercer, 1987; Lemke, 1989; Moje, 1995; Mortimer, 1998; Mortimer & Scott, 1994; Pea, 1993; Scott, 1998).

(2.2) Everyday practice and authentic science education

The discussions about scientific practices give impact upon the authentic pedagogy discourse in the science education area, which supports better teaching models and their theoretical grounds for instructional reform. Such discussions provide a new horizon for the authentic pedagogy policy which explores curricula and instructional methods containing connections to the respective social world. In particular, in the constructivist discourse in science education, the significance of knowledge “in use” has been emphasized. Along with its emphasis on practice in social context, the assumption of authenticity in science provides for innovative minds a resource about what classroom science should be, making them assume what classroom science could be.
Nonetheless, we find that while the social nature of science knowledge seizes interest in the discourse for authentic science education, we still wonder how such authentic discourse could be realizable in science education. Most of all, we can discover in the authenticity discourse in science education, the conventional image of science, which is a naively designed inductive way of inquiry suggested for instruction method. One possible reason why it is so can be found in the fact that a theoretical model of authentic science learning recommends the social properties of science, such as activity, context, and authenticity, as an engine of accomplishing scientific concepts. In particular, the discourse of authenticity in science education gives attention, in scientifically learning, to everyday practical knowledge along with symbols and procedure, which then is assumed to make the ordinary activities scientific. For example, Driver et al., (1994) formulate of the status of the commonsense knowledge as residual necessity for acquisition of scientific knowledge. Driver et al. (1994) note:

"Commonsense" ways of explaining phenomena, as pictured here, represent knowledge of the world portrayed within everyday culture. They differ from the knowledge of the scientific community in a number of ways. Most obviously, commonsense and science differ in the ontological entities they contain: The entities that are taken as real within everyday discourse differ from those of the scientific community. Secondly, commonsense reasoning, although it can be complex, also tends to be tacit or without explicit rules. Scientific reasoning, by contrast, is characterized by the explicit formulation of theories that can then be communicated and inspected in the light of evidence. In science, this process involves many scientists in communication with one another. Although tacit knowledge undoubtedly has a place in science, the need for explicitness in theory formulation is central to the scientific endeavor. Thirdly, everyday reasoning is characterized by pragmatism. Ideas are judged in terms of being useful for specific purposes or in specific situations, and, as such, they guide people's actions. The scientific endeavor, on the other hand, has an additional purpose of constructing a general and coherent picture of the world. The scientific commitment, therefore, is not satisfied by situationally specific models, but strives for models with the greatest generality and scope. (p. 8)
Irony here is that while authenticity discourse recommends the use of everyday reasoning as a better way to learn science, it preserves the demarcation between everyday knowledge and scientific knowledge. Generally, the assumption of the uniqueness and authenticity of scientific reasoning is often based upon the distinction between disciplinary experience and mundane experience. We could commonly find authenticity, particularly in theoretical discussions of everyday knowledge and scientific knowledge. For instance, Garrison & Bentley (1990), explicating why teaching concepts in natural science is so difficult, provide a discussion of the uniqueness of scientific knowledge. They find an answer to the question in the fact that the ecology of a scientific concept resides in, and that it is different from that of commonsense knowledge. According to them, disciplinary understandings including science and everyday experience belong to different worlds.

They find such a clue in extending the limited notion of cognitivism assumed in the model of conceptual change in terms of the Wittgensteinian underpinnings in Kuhn's study. Kuhn (1962), in his explication of the growth of scientific knowledge, has taken Wittgenstein's point that learning is more than rule-acquisition. According to them, a demarcation between everyday knowledge and scientific knowledge implicates more than the duality of theory and practice. Rather, borrowing the Schutzian perspective of "multiple realities," they rely on the notion of multiple communities of practice. Their reliance on the notion of communal resource of cognition and practice is similar to an assumption of "communities of practice" which is postulated in situated learning theory (Lave & Wenger, 1991). In this way, they suggest an explanation of the legitimacy of disciplinary culture of science. Their argument implies that the content of what practitioners do is centrally the conventions of communities, which demarcates them from other communities of practice. As a result, a problem in education elicited by the assumption of preservation of demarcation is that such theoretical treatment of practice, commonsense knowledge can imply a wrong image of what the members of community
of practices in the social world out of school actually do, and then can turn it into
discourse for a way of the better teaching science.

In similar, while knowledge acquisition in constructivist discourse is not assumed to
be grounded upon, so called, "foundations," the notion of “authenticity” in science
education still points to methods to accomplish the stable condition of science. Rather
than naive induction or personal empirical inquiry, it has emphasized “conceptual
activities,” through which the scientific questions, problems, and explanations are
assumed to be created. Meanwhile, the distinctive status of science is preserved in such a
theoretical concern. Social constructivists recognize conceptual knowledge as a set of
tools, so thus argue that learners need to be given access not only to physical experiences
but also to the concepts and models of conventional science. While recent constructivist
discussions in science education have emphasized social context in which knowledge is
used, on the other hand, it preserves the notion of science as “an integral, self-sufficient
substance, theoretically independent of the situations in which it is learned and used”
(Brown, et al., 1991, p. 32). This is so consistent in the way to treat social feature of
knowing such as social interaction including practice or activity in larger educational
studies, in which theoretical discussions of practice implicate teaching models which
design activity methods as force for cognition development. Such discussions slips into a
repertoire of reform discourse, and supports for its assumptions and ideas. Sometimes,
they raise controversial theoretical debates regarding the nature of knowledge and its
pedagogical implications (e.g., Osborne, 1996; Slezak, 1994; Staver, 1998).

In sum, authenticity in science education has been a persistent issue in the science
education reform movement. The professional work of science has been taken as a
reference for the authenticity of science lessons. Constructivist theories and claims have
explicated authentic science instruction in the similarity between scientists’ practice and
science classroom students’ learning process. It has been iterated in various forms of the
model of, for instance, discovery learning in science education. This model has been
consistently pursued and constructivist claims and theories, whatever their difference is,
have supported the idea of constructive teaching for students’ cognitive growth.
Meanwhile, whenever the pedagogical effort takes up authenticity, it tends to preserve the
demarcation of science knowledge from non-science, and thus anchors the authenticity in
the stableness of knowledge domain. The problem then is that such endeavor tends to
betray its own promise that better understanding of the nature of science could offer a
model for more authentic science education.

On the other hand, a new understanding of scientific enterprise has problematized
such a demarcation in the canonical view of science, reconsidering the image of unified
method, the relation between theory and observation, and the stableness of theory. In this
view, authenticity of science is implied not so much as a settled feature of the science
enterprise but as its occasioned achievements in and as the ongoing activities. Instead of
taking the discussions in SSK as a resource for devising new teaching models, we can
reference to them in order to examine the discourse of authentic science education which
concerns how this or that activity in science classrooms could be possibly related to
“science,” or how it could not be. In particular, if demarcation criteria of science and
everyday practice, as SSK have illustrated, is hardly preserved in scientists’ daily practice
in the community of practices, we could wonder to what extent we could pursue the very
idea of authenticity in science education. Otherwise, even if authenticity in science
education is still valued to be pursued, we could wonder to what extent the setting’s
feature of school classroom particularly in early grade level could absorb the “real”
shapes of professional work of science. Such a problematic about the possibility of
reform is also another rationale that leads one to re-consider a larger issue about that of
instructional reform which is related to authenticity of knowing and doing.

4. Persistence of instructional reform

Cases of school reform in the Western communities have often shown programs with
which the Korean educators and administrators could consider as models for their current
reform policies. To the Korean community, whose history of public school is not so long,
it has been important to find successful cases of reformed schools in the Western
community, especially regarding Open Education. Many researchers and educators have examined such cases, and some of them have even visited Western schools, looking for successfully reformed schools. They reported the formal organizations of the school classrooms from what they had observed, and have given their efforts to the explorations of virtual implications for the current Korean conditions. Among those who expect the realization of new models in the cases of the foreign country, there are some who tend to think that new models, such as activity-based or child-centered instruction which the reform pursues is Western-originated from the outset. Thus, they worry about the fact that it could be inappropriate to the Korean circumstances owing to the different culture, histories, emotions, behavior modes, beliefs, and tradition between each other.

Nonetheless, setting aside the question of how far the reform programs mentioned above would be different from ordinary school practice, there has been a history of problematics of school reform in the Western community (Cuban, 1982, 1990; Fullan, 1991; Sarason, 1971, 1990; Tyack & Tobin, 1994; Tyack & Cuban, 1995). That is, the stability of mundane classroom instruction has frustrated generations of reformers who have sought to change it. It yields a question of why, after decades of planned changes aimed at improving teaching, many of the reforms which contain similar claims and intentions appear repeatedly in the history of the modern public schooling. Earlier discussions of progressivism, child-centered instruction, innovation method, including various activity modes, and the recent systematic discourse of constructivism have yet coherently served the reform discourse for student-centered instruction. For educational reforms historically have waxed and waned again and again, across cyclical or pendulum-like swings, conflicts of political values, the loosely coupled structure of schools as institutions, or the imperatives of classroom structure and teaching as an occupation. Above all, the problematic of the persistency of reform has to do with the fact that teacher-centered lesson is durable even in the face of efforts to move classroom lesson toward student-centered activity (Applebee, 1974; Applebee, Langer, & Mullis, 1987; Cuban, 1993; Goodlad, 1984; Hoetker & Ahlbrand, 1969; Stake & Easley, 1978; Suydam, 1977; Westbury, 1973). Cuban (1993) concludes from his study of the reform
history in US that a substantial body of evidence shows the dominant teaching tendency was towards varied forms of teacher-centered instruction from the 1890s to the present.

In fact, it is commonly visible among school teachers that when a teacher believes herself to be fully aligned with a constructivist perspective in her classroom, she can still be far closer to her conventional practice than she imagined (Cohen, 1990). Cuban (1989) characterizes the problematic of the persistence of reform as “the more something changes, the more it remains the same” (p. 376). According to Cuban (1989, 1990), an impulse toward improvement is not just recent movement but so durable that reforms flow and ebb throughout the history of schooling, regardless of where and when the reform is issued. He points out that we cannot entirely deny the fact that there have been changes in the history of schooling. For example, he categorizes change generated from reform with two different layers of order. According to him, first-order changes include “modifying certification standards for teachers and administrators, raising salaries, selecting smarter textbooks, adding (or deleting) courses to (or from) the curriculum, scheduling people and activities more efficiently, and introducing more effective forms of evaluation and training” (p. 374). Second-order of change refers to alteration of the fundamental ways of organization. However, Cuban observes that we seldom see the second-order change in the history of reform while there has been a series of first-order changes:

Occasionally, certain second-order reforms such as student-centered instruction, nongraded schools, team teaching, and open-space architecture have been attempted in isolation, or uncoordinated with other efforts, with little enduring effects other than occasional adaptations by individual teachers and administrators. Finally, there have been curricular reforms aimed at second-order changes in teaching and learning (the “new math,” “new biology”) that have been transformed into first-order changes - ending up in classrooms as another set of textbooks (Cuban, 1989, p. 375).
Cuban (1989) suggests a few explanations about why reform persistently recurs in various ways. First of all, he gives attention to the fact that school reforms are used to adapt to expectations towards school as an agent of change for larger society or its relationship with school organization. For instance, Cuban finds historical cases in the US in which school reform is working virtually as “symbolic solutions” to the national crises that follow political and economic cycles of larger society, e.g., economic competition with Germany in the nineteenth century, Sputnik crisis in the late 1950s, trade deficits with Japan in the 1980s, or adult and youth problems of chronic unemployment, intemperance, etc.

Also, Cuban attends to the fact that it is not easy to tell the success or failure of a certain specific reform. As a matter of fact, many normal classrooms in public schools look like they are in the middle of this continuum between success and failure. Above all, as Cuban (1989) argued, the criteria with which reform policies and implementations are measured are not only ambiguous, because there cannot be definitions of what the reform and actual implementation would look like, they also depend on each school and each teacher. In addition, the repeated construction of crises and reframing of national problems into school solutions blur the very possibilities of success and failure. As Tyack (1990) observes, where reform is concerned, “vague is vogue” (p. 170).

Scholarly explanations about difficulties of substantial change in classroom practice, in view of the relationship between larger society and local schools, have also been suggested in critical educational studies (Apple, 1977, 1982; Aronowitz & Giroux, 1987; Bernstein, 1977; Carnoy & Levin, 1985; Denscomb, 1982; McLaren, 1986; Popkewitz, 1988, 1991; Popkewitz, Tabachnick, & Wehlage, 1982; Willis, 1977). These scholars argue that schools are used to re-inscribe social order, while the capitalist system is driven by ideological imperatives that permeate all institutions in the culture. They have also asserted the over-determination of local settings by social structure. With this analytic tactic, they explore a possibility from the contingencies, and unexpected outcomes for the reproduction of social structure in local settings. They assume that social structure pervades every layer of social life, which then would be revealed in social agents'
consciousness and action in local settings. Simultaneously, social agents do what they do with self-determination about their use of consciousness and act in their everyday activity setting. This approach concerns how social structure is saturated in an individual's consciousness and practice. Apple (1990), in his well-known book, Ideology and Curriculum, notes that:

[T]he control [of schools, knowledge and everyday life] is vested in the constitutive principles, codes, and especially the commonsense consciousness and practices underlying our lives, as well as by overt economic division and manipulation. (p. 4)

They treat the school classrooms as a "relatively autonomous institution" following the neo-Marxist concept (Apple, 1979). Schools are instruments to express and maintain those ideologies but seldom alter them. They have argued that the emphasis on authority and responsibility in classroom rules and procedures constitutes a "hidden curriculum" which socializes students to the world of work or to adult roles in modern bureaucratic organizations, and that classroom rules contribute to the reproduction of dominant social and cultural arrangements. According to this view, most of reforms are for display, not fundamental change. Popkewitz (1988) argues that "participation in the activities of reform functions as a ritual of affiliation to existing practices" (p. 82). He observes that only those reforms that strengthen prevailing ideologies get implemented. In this way, this approach suggests an explication about the limits of educational reform primarily in relation to the larger structural constraints to the contemporary institutional practices of schooling.

Another reason of persistency of reform Cuban (1989) explicates lies in more local context of reform. It has to do with organizational complexities between policy makers, administrators and practitioners. He points out that there are discrepancies between each organization in their personal and professional perspective on schooling, reform or the implementation process. Meanwhile, how to teach is a matter that depends on teachers who are the ones who centrally organize their workplace. Reforms tend to address the
transformation of texts or tests, because texts and tests are "standard bureaucratic tools used to control what teachers do in their classrooms" (Cuban, 1990, p. 11). When the passions for reform begin to decline, policy makers blame the teacher's incompetence or idleness in embracing the new methodology of teaching, and on the other hand, the teachers complain that administrators and policy makers never understand the situated constraints of their classroom practices.

We could possibly find several more rational reasons about the recurrence of reform. Those explanations might shed light on still other aspects of the problematic of school reform. Nonetheless, when we turn our attention to ordinary classroom practices, we still have little clue about why reform recurs. It is particularly so, when we observe the classroom lesson as remarkably stable and familiar enactment. As a result, those who have never experienced beyond the current daily practices wonder what it could be transformed into. Cuban (1987) has raised such a problematic, even though his explication of it seems seldom viewable:

Reformers...seldom ask the basic questions: How do teachers teach? Why do they teach the way they do? Instead, they frequently leap to the question: How should teachers teach? In doing so, these policy makers and practitioners often harvest disappointment from reform expenditures.... Thus the premature question — How should teachers teach? — yields a shallow conclusion for reform failures: intransigent teachers were to blame. Asking for prior, more fundamental, questions about existing practices and investigating what those practices yield produces a very different analysis. (p. 34)

5. Conclusion

This study pursues a problematic of the persistence of educational reform in the recent Open Education movement in Korean context, specifically in fields of science classroom in early grade level. In particular, regarding science classroom settings, what leads us to
reconsider the possibility of the reform discourse and constructivist discussions in science education comes from the doubt of the very idea of authenticity as criteria of a reformed model of science lesson. While reform-minded researchers and practitioners give efforts to pursuing the authenticity of classroom pedagogy in the social connection of curricula and teaching methods, SSK literature tells us that we can hardly preserve authenticity of science in terms of its demarcation of the mundane practice. In other words, it illustrates that any singular, fixed procedure or methods which could characterize the uniqueness of the scientific enterprise is hardly observed in competent members' practices within the community of the scientific enterprise.

Therefore, the reference to such a perspective on science in this study is particularly necessary, not because it is expected that a better understanding of science would indicate a more correct direction to pedagogical efforts for authentic science lessons, but because we need to understand the extent of the limits which the very efforts to implement authentic science pedagogy could possibly show. Such a problematic leads this study to a question of how we could understand the actual fields of the everyday classroom lessons and the mundane practices in them. It concerns analytic perspective and method in which one can comprehend the social organization of mundane classroom practices.
CHAPTER 3

METHODOLOGY

1. The routine grounds of classroom lessons: The tradition of inquiry into classroom interaction

This study is a descriptive study of several science classrooms in Korean elementary schools, based on the detailed analysis of the everyday practices of classroom science teaching. This study also considers how the practical circumstances of everyday classroom settings would appear in relation to the intended, planned features for Open Education. For the examination, this study investigates, in the classroom observed, how classroom lessons are grounded in routine activities, which are publicly, jointly crafted by the teacher and students, and how they shape the curriculum for both teacher and students alike.

Analytic exemplars for the study rely on various resources for the detailed descriptions of classroom practice. The analytic task is to uncover what the social organization of classroom practice looks like in the observed elementary science classrooms. Instead of demonstrating a scenic view of the Korean way of school life, a closely focused observation is needed in order to examine the contextually organized character of everyday classroom practice.

This task requires a contextual approach in which the contextual organization of the
ordinary practices of classroom lessons would be comprehended. Mishler (1979) argues that even though it is not so surprising to observe that human action and experience are context dependent and can only be understood within their contexts, the importance of context has been largely neglected in educational studies. Nonetheless, the approach to contextual practices in everyday classroom lessons is not so unfamiliar in educational studies. The tradition of interpretative studies of classroom pedagogy has suggested an alternative to the linear, causal process-product model of educational studies (see Cazden, 1986; Erickson, 1986, 1994 for a review).

An interest in capturing the contextual features of knowledge construction in classrooms is not unique to modern educational research. The centrality of context has been an interest of educational studies for a long time. John Dewey is perhaps the most widely recognized proponent who had interests in the social nature of education. Alongside his approach to school policy and practice, Dewey had distinctive pedagogical and philosophical views. His view of science and the relationship between science and practice stood in contrast to that of Thorndike’s behavioral psychology (see Beatty, 1996; Kliebard, 1986; Lageman, 1989; White, 1982). Dewey’s view of education was far more ecological than behavioral psychology, and went on towards an understanding of the social complexities of education. Thus, it found much greater affiliation with philosophical pragmatism in those days and impacted on sociological formulations later (Westhoff, 1995). While Dewey’s view tried to motivate a contextually-sensitive interest in pedagogical studies in those days, it was not developed. As Lagemann (1988) observes, “one cannot understand the history of education in the United States during the twentieth century unless one realizes that Edward L. Thorndike won and John Dewey lost” (p. 185).

The appreciation of the contextual character of practice in educational literature has been revealed in various forms in educational studies, which reflect various interests and, more importantly, different approach to contextual organization. As Greeno (1997) indicates in his argument for situated cognition, studies of social interaction have developed in diverse branches of social science; ethnography, ethnomethodology,
symbolic interactionism, discourse analysis, and socio-cultural psychology.

Above all, the contextual organization of meaning and action has been one of the main issues in interpretive sociology which has grounded a tradition of studies of interaction. Goffman (1964), in his paper “The neglected situation,” argued that the situated character of social life had been neglected in the studies of social behavior. His critique was aimed at professional sociologists’ preoccupations with societal functions in which the social organization of ordinary worlds remained unexamined. Also, and much earlier, in his “Situated actions as vocabularies of motive,” Mills (1940) claimed that the language of “motive” had been saturated with psychologism, and that “motive” must be understood for its use as a situated attribution.

The effort to comprehend the contextual nature of actions in everyday settings in the interpretive approach has a long research tradition in the communities of educational studies. Waller (1932) suggested that educational researchers give their insight into the nature of the total situation of the school under the principle that all education comes from the child’s experience of social situations. In his book, The Sociology of Teaching, Waller formulated this characteristic as follows: “[T]he fundamental problem of school discipline may be stated as the struggle of students and teachers to establish their own definitions of situations in the life of school” (p. 297). Waller’s was an early sociological study of instruction (Also see Gearing & Sangree, 1979)."

Within interpretive social studies, educational studies have developed an approach which understands the students’ experience of classroom curriculum as the work of a “culturally responsive pedagogy,” as Erickson (1991) termed it. This approach goes back over the last thirty years. Focusing on the role of cultural communication style, this

---

16 It should be noted that contextual knowledge in school has also been an ongoing topic for symbolic interactionists in the UK. They have deployed “the definition of situation” to describe situations of conflict and collaboration between teachers and students (For reviews, Atkinson, Delamont & Hammersley, 1988; Hammersley & Woods, 1976, 1984; Woods, 1980a; 1980b; 1983; Woods & Hammersley, 1976).
approach began to shed light on the contextual feature of classroom practice. These studies have shown how students' experiences of the classroom curriculum would closely relate the organization of "participation structures" (see Erickson, 1982, 1986, 1991 for reviews; also see Cook-Gumperz, 1977; Erickson & Mohatt, 1982; Erickson & Shultz, 1977, 1981; Jacob, 1997; Mehan, 1979, 1981; Philips, 1972). Erickson (1982) argues that:

[The social participation structure places gatekeeping constraints on the individual's access to information sources and help — information available in speech, writing, and physical objects, and the help available in the actions of other people. (p. 168)]

The construct of participation structure concerns the rights and obligations of participants with respect to who can say what, when, and to whom. This approach concerns the competence and accessibility to the target information. For instance, Philips (1972) contrasted patterns of participation structure between situations at home and at school, and demonstrated the relationship between school success and communicative competence from classroom culture and children's ethnic background.

Different titles have been available for this approach owing to different analytic policies and interests, such as the microethnography of classroom instructional events (Cazden et al., 1980; Erickson, 1977; Erickson and Shultz, 1982; Michaels and Cook-Gumperz, 1979), the general ethnography of communication (Health, 1983; Philips, 1972), constitutive ethnography (Mehan, 1979), and the ecological environment of interaction (Cook-Gumperz and Corsaro, 1975), which represent approaches to discover specific points of difference in the organization of participation structures as an essential task in the study of cross-cultural communication in the classroom.

By and large, efforts to investigate the context of school classrooms have brought out two significant programs of educational studies. On the one hand, this approach has reversed the Parsonian approach of the study of schooling as social agent. Parsons (1959) brought into view the school as a social system, and the relation of its structure to its
primary functions in the society as an agency of socialization and societal allocation. Instead, some educational researchers argued that such a large-scale sociological approach might be inappropriate to the task which is to examine the internal process of schooling. Mehan (1979) notes:

[I]f we are to understand how so called input factors like social class, ethnicity, or teachers' attitudes influence educational outcomes, then their influence must be shown to operate in the course of interaction among participants in actual educational environments. (p. 5)

More commonly, classrooms and teaching have been studied from the perspective of linear causal models especially by educational psychologists and positivist social researchers. A kind of hybrid behaviorist process-product model, as termed by Dunkin and Biddle (1974), has been devised to examine the correlation between the input of a particular pattern of a teacher's act, such as questioning or motivational statements, and outcomes such as certain changes in test-taking behavior by students (Brophy & Good, 1986; Gage, 1978; Gage & Needels, 1989; Rosenshine & Furst, 1973). Through the systematic use of predetermined code categories, this model promises an effective research design for analyzing the effectiveness of instructional practice. Preserving the assumptions from such a model, many schemes have developed to quantify the frequency of various patterns of classroom practices. Concerning social context, this model usually treats a collection of “presage conditions”: variables like student age, grade, socioeconomic status, and gender, etc. (Evertson & Green, 1986, p. 187). Many process-product studies of classroom instruction aim to explicate these conditions. The goal of such an approach is to control or minimize contextual factors in order to reduce “noise” and discover general laws of behavior.

For example, Flanders' system of classroom instruction was one of the most widely used quantification schemes in coding classroom practice (see Dunkin and Biddle, 1974 for review of many such schemes). The procedure to make field data intelligible includes on-the-spot coding of teacher and student behavior. Flanders provided seven categories
for "teacher talk" [(1) accept feelings, (2) praise or encourages, (3) accepts or uses ideas of students, (4) ask questions, (5) lecturing, (6) giving directions, (7) criticizing or justifying authority], and two for "student talk": [(8) response and (9) initiation]. While the coding system determines the very nature of classroom events in a unidirectional form from teachers to students, the contingent nature of interaction, which seems to be the nature of interaction itself, tends to be neglected.

A systematic critique of such coding systems can be found in Heap's (1981) argument. Heap examined closely Durkin's study (1979) that used a variation on Flander's coding system. Durkin studied the percentage and distribution across classrooms and grades of time spent on "comprehension: instruction" in reading lessons. With this interest, Durkin's study was to code only teacher's behavior, which then was classified into the most important categories of comprehend: assessment, comprehension: instruction. Heap demonstrated in detail how such a unidirectional model and coding system would miss in every single case the sequential organization of classroom events. He pointed out the assumptions implicated in unidirectional models: First, the unifunctionality rule in which categories are mutually exclusive; each event is considered as having one function; second, the sequential irrelevance rule in which the actual sequential organization is irrelevant to the task of analyzing relations between coded event functions; third, the cotermination rule in which no function outlives its event. These three assumptions serve to decontextualize classroom behavior. They rely on, but take for granted as nonproblematic, the fact that the coder should see and understand the situation in order to tell the teacher's intention to determine the identity or function of her behavior (the fourth rule of determinance). The most implicative point of Heap's critique can be formulated that the coding itself could be determined by the interactional organization of classroom events, but not vice versa.

On the other hand, the essential assumption of naturalistic classroom interaction studies is that the social structure and outcomes of institutional processes are produced in the process of face-to-face interaction. According to this approach, social context does not predetermine human actions. Rather, contexts refer to what people are doing and
where and when they are doing it. Erickson & Shultz (1981) note:

*The production of appropriate social behavior from moment to moment requires knowing what context one is in and when contexts changes as well as knowing what behavior is considered appropriate in each of those contexts. (p. 147)*

Instead of a decontextualized code or category, the interpretive approach has articulated the local character of learning environments, which teachers and students constitute collaboratively together, e.g., the locally distinctive patterns of performed social identity of enacted statuses and their attendant role relationships. From the interpretive perspective, these studies have developed plentiful outcomes of descriptive analysis of classroom events (see Erickson, 1986 for a review of interpretive approach).

Alternatives to the process-product model have been developed by various lines of social inquiry such as discourse analysis, socialinguistic, ethnography of communication (see Cazden, 1986 for a review). Most of all, it needs to be noted that the efforts to comprehend contextually organized features of classroom instruction have been supported by an examination of classroom language use. The construction of the classroom context and its meaning, above all, has to do with the use of language in face-to-face interaction. In the 1970s, Sinclare & Coulthart (1975) investigated the relationship between language form and the functions of language. They relied upon an assumption that language use in school classrooms does not represent something beyond its use, but rather determines its meaning within its use, *in situ.*

Based on speech act theory (Austin, 1962; Searl, 1969), they were critical of the formal semantic view of language that the function of language is to represent something which it refers to. Austin (1962) showed that people do things with their words besides refer to objects. There are classes of actions, like apologizing, promising, pledging, that are accomplished by the very act of speaking words. Sinclaire and Coulhard asserted, in their study of classroom events, that the meaning of an utterance is determined by its illocutionary and prelocutionary force, i.e., how one particular context guides the
interpretation of grammatical structure. For example, "Can you play piano, John?" represents grammatically the form of a question. However, it is not difficult to notice that if it is uttered in a certain classroom context, it can be heard immediately and unequivocally as a request. While they identify the function of speech in discourse, they rely heavily on grammatical features and the normative distinctions between channels of communication. For example, they distinguish elicitations and directives based on the "modality" of the response. The former is defined as a request for a verbal response, and the latter functions as a request for a nonverbal action.

The interactionist approach has developed analytic insights regarding the language of instruction and how semantic interpretation of the instructions depends on synchronization and temporally situated actions. For instance, Cook-Gumperz (1977) has examined a case of children's understanding of the communicative requirements of instruction and direction-giving in situations that install some constraints on the activity (as in formal school learning). In the study, pairs of children were asked to make a model using a kit of color-coded straight and circular pieces of wood. Her close analysis of actual occasions reveal, rather than one-sided movement on the part of the child "model builder," cooperative patterns where instructor and builder had an ongoing dialogue. She identifies, along with the structure of narrative as outlined by Labov, "abstract, orientation, complicating action, evaluation and resolution." For instance, she shows various ways of using imperatives containing pronominals to guide the action; e.g., "Remember that piece you had before / Well that one / you need another one like that one" (p. 120).

Contextually organized features in classroom are varied in discernible ways in specific time and place. Cazden (1986) points out that participants "speak within the structure" rather than "learn the structure," because the students may be learning "the meaning of local cues, such as the teacher's posture and intonation, rather than the structure of the speech event as a whole" (p. 437). Especially in the US, this approach has developed the notion of "communicative competence," which entails a way to communicate expected participation structure is through the use of "contextualization
cues.” According to Gumperz (1982), contextualization cues refer to:

[C]onstellations of surface features of message form...by which speakers and listeners interpret what the activity is, how semantic content is to be understood and how each sentence related to what precedes or follows. (p. 31)

For example, Erickson (1996) explicated how the physical and temporal organization of classroom interaction works as the ecology of a learning environment. In his close analysis of a kindergarten-first-grade classroom, he observed how such an environment would be formed around one target child. He argued that for classroom participants the access to intelligible information would require the capacity to “go for” crucial moments in the interaction, by which he meant the collective organization of attention as a necessary condition for gaining information. Erickson claimed that such moments can be organized collectively rather than dyadically, e.g., by other students as well as a teacher.

Erickson and Schultz (1977) have analyzed within-situation change from one phase of an event to another. Their methodological paper “When is a context?” brings into view the sequential nature of contextual knowledge. According to them, our sense of sequential organization works as “an interactional fail-safe mechanism” (p. 150), in which interactants get the socially meaningful message, despite individual differences, i.e., cultural difference, the level of competence, or individual variation in focus of attention at any given moment. Those factors construct the meaning of classroom events in that they constitutively work on what students can or cannot do, and how they do it.

One well-known comprehensive study of how contextual knowledge in classroom setting would be sequentially organized can be found in Mehan’s analytic studies. Mehan (1979) suggested a “constitutive ethnography” of classroom events as an alternative to the failure of process-product model to comprehend the “mutual constitution” of meaning in the social scene of classroom lessons. Mehan argued that culture is an interactional phenomenon instead of either subjective state or an objective thing, and what is only available either to the interactant members or to the researcher in social scenes is
interactional competence. A “constitutive approach to ethnography” is recommended to examine educational environments as the interactional machinery to produce social reality. This policy brings into view the fact that in classroom settings, the students operate on the world, including the teacher, as well as the teacher operating on the students. As the interactional machinery peculiar in classroom setting, he identified the segmentation of classroom instructions into “IRE sequences” in school lessons; Initiation-Reply-Evaluation sequences. As Erickson (1986) notes, IRE sequences demonstrate more global aspects of interactional patterns of the classroom practices that differ from the other settings. Thus, IRE has become a popular analytic model for classroom studies (see Wells, 1993).

Studies of classroom interaction, in their emphasis on construction of meaning and the social context, closely parallel educational studies which have recently asserted a “social constructionist” turn. Yet the two approaches show a different picture of classroom settings from each other. The analytic perspective of classroom interaction studies demonstrates the local social organizations in which meaning, order, sense and practice of the mundane classroom lesson are built, and thus how familiar classroom practice is enacted in and as its social organization. On the other hand, much of the social constructivism in educational studies has been pursued in theoretical discussions of how one learns and knows, and some of these considerations explore their applications to classroom teaching methods (see von Glasersfeld, 1995; Wertsch, 1991).

This study takes up what could be the durable conditions of classroom instruction, and how classroom interaction studies have pursued the contextual organization of classroom lessons in its own right, without deploying a decontextualized model. In decontextualized models of classroom practice, coding practices rely on their background understanding of everyday phenomena while searching for a correspondence between the coded phenomena and coding system (Also see Dreyfus, 1983 for a discussion of background understanding). Background understandings are then both taken for granted, and organize the analysis. On the other hand, this study is interested in the very existence of those background understandings which make the social phenomena non-problematic,
or so naturalized that we cannot imagine how to do otherwise. This study problematizes how the reform discourse tends to take its settings for granted, probably owing to their familiarity for us.

2. Ethnomethodological studies of the routine ground of everyday practice

In order to pursue the purpose at hand, this study relies on ethnomethodological (EM) studies of situated action, among the several deployments of a “contextual approach” in educational research (see Button, 1991; Garfinkel, 1967; Heritage, 1984; Lynch, 1993). The interpretive approach for a study of classroom interaction has been conducted in diverse enterprises in educational research literature (see Denzin & Lincoln 1994 for an overview of the various lines). A number of alternative approaches and methods to the process-product model in studies of classroom interaction (e.g., ecological psychology, phenomenological research, sociolinguistics, and symbolic interactionism) have developed their own analytic programs in the educational research community (see Atkinson, Delamont, & Hammersley, 1988, Jacob, 1987; Mishler, 1979 for a review of qualitative inquiry in education). The language of such branches in interpretive research presents its own distinctive reality-constituting endeavors, with different interests, goals, and strategies. Among them, EM studies provide an appropriate analytic perspective for this study which is particularly interested in bringing into view the durable conditions of the routine grounds of classroom lessons, which render classroom scenes both stable and familiar.

(1) Ethnomethodological studies

The premise that practical reasoning and practical action are properly parts of the subject matter of social studies is due to the emergence of a branch of sociology named ethnomethodology. EM studies purpose to bring into view how people make use of their background understandings and practical competences or methods to make their activities
and settings understandable to each other and thus constitute social order and common understanding. Ethnomethodology does not refer to a unified program of social inquiry, but has been developed into family-resembled forms of studies. As the term ethnomethodology suggest, it refers to an approach to the study of the “folk methods” through which social actions are produced and made intelligible. In the early 1960s, it was announced by Garfinkel’s study which has set itself apart from Parsonian structural-functionalism (see Heritage, 1984 for a discussion of its relationship with Parsonian sociology). In the Parsonian proposal, collective norms are figured to organize social action and in this way to order social reality. It represented a longstanding tradition in the history of social inquiry since the 1930s.

Turning from Parsonian normative sociology, ethnomethodological studies began to take everyday life and practice as a social science topic rather than as a resource for social science analysis (see Zimmerman & Pollner, 1970 for a discussion of the difference between everyday life as resource and topic). Drawing upon the work of the classic phenomenologists, Garfinkel pointed out how the routine nature of everyday life has been neglected in the sociological studies. In the early 1950s, Alfred Schütz (1962), in his pursuit of the constitutive phenomenology of the world of everyday life, proposed social inquiry as a description of “the foundational structures of what is pre-scientific, the reality which seems self evident to men remaining within the natural attitude” (Schütz and Luckmann, 1974, p. 3). Schütz claimed the stability and meaningfulness of everyday world may be achieved through and in the mutual intelligibility of members’ practices

---

17 Here, the common sense world, the world of daily life or everyday world is variant expressions for the intersubjective world experienced within what Husserl terms “the natural attitude.” According to Schutz (1962), the world of daily life into which we are born is from the outset an intersubjective reality which is known or knowable in common with others. He also notes that as far as we act not only upon but within the world, the world is experienced pretheoretically as a durable condition of all the members’ projects (see Schutz, 1962 for constitutive sociology of the everyday world; Berger & Luckman, 1966 for a constructivist sociology of the everyday world; also see Douglas, 1970 for collected papers on the respective issues).
rather than transcendental consciousness. His argument suggested that any scientific understanding of human action should begin with and be built upon an understanding of the everyday life of the folks performing those actions.\(^\text{18}\)

EM studies find an analytic way of treating everyday practice as empirically available for description. Garfinkel (1967) explicates the fact that the routine practices of the everyday world are both a condition and an outcome of members' activities. He notes, "Familiar scenes of everyday activities, treated by members as the 'natural facts of life,' are massive facts of the members' daily existence both as a real world and as the product of activities in an real world" (p. 35). He points out that this point has been largely neglected in social studies; "...courses of common-sense rationalities of judgment which involve the person's use of common-sense knowledge of social structures over the temporal 'succession' of here-and-now situations are treated as epiphenomenal" (1967, p. 68). Garfinkel explicates the routine nature of the 'seen but unnoticed' procedures for producing normal courses of action. EM studies focus on the fact that the taken-for-granted structure of the everyday world, including members' tacit knowledge of social structure or his sense of flow of circumstances, could be visible and accountable among lay or professional members in the everyday world.

---

\(^{18}\) In regard of bringing into view a topical treatment of the everydayness in social studies, Herbert Blumer, the founder of symbolic interactionism, deserves mention. Blumer (1953) criticized traditional social science in his article "What is wrong with social theory?" He observed that investigations by social studies tended to treat meaningful action as the playing out of various determining factors, all antecedent and external to the action itself. For the argument, he points out that concepts in social science are "sensitizing" rather than definitive, in that whereas definitive concepts provide prescriptions of what to look, sensitizing concepts suggest directions along which to see. The immanent, practically objective nature of the social world would never be grasped by predetermined factors.
(2) Key analytic concepts for the examination of local adequacy

Ethnomethodological studies show a family resemblance, but they do not have a shared machinery of analytic program among them. Nonetheless, there is a virtual consensus of analytic orientation to understand the contextually organized features of the everyday world in which practical reasoning and practical actions are context-sensitive. Rather than as formal methodological principles, the following concepts have to do with an "ethnomethodological" treatment of recurrent problems encountered in the course of conducting the study at hand.

(2.1) Indexicality

Indexicality, in philosophy of logic, has been defined as a word whose meaning depends on the context of its use, or the nexus of concrete time and space in which it is used. Indexicality or indexical expressions includes pronouns such he, she, and it, deictic expressions like here, there, this, that, token and idiomatic expressions, etc. They are expressions that cannot be determined without context. Garfinkel and Sacks (1970) expand the pervasive relevance of 'indexicality' in all representations, statements, utterances and activities of social life and meaning. They make the radical proposal that indexicality is an essential feature of all acts and utterances. This means that words or isolated statements do not have an identical meaning, and definite sense and reference can only be achieved in local situations of use.

According to Garfinkel and Sacks (1970), all sociological reasoning is the effort "to remedy the indexical properties of practical discourse" (p. 339) by substituting "objective expressions." For example, in case of context-bound expressions like "The water's hot enough now" (Lynch, 1991), formal analysis works like a coding system, and would replace those kind of expressions with stable context-free expressions like "Water boils at one hundred degrees Celsius." However, as Garfinkel and Sacks (1970) note, "there is no room in the world to definitely propose formulations of activities, identifications, and contexts" (p. 359). The relationship between indexical expressions and "the corresponding contents" are irremediably situated. For instance, ordinary people use
indicator terms effectively and intelligibly without having to establish separately out of the ongoing situation what they mean. Rather than relying on extrinsic resources like a fixed domain of substantive content or shared agreement, the indexicality of practical action and practical reasoning is made use of to achieve the stability and familiarity of ordinary worlds. As Garfinkel (1967) notes, the "demonstrably rational properties of indexical expressions and indexical actions is an ongoing achievement of the organized activities of everyday life" (p. 34).

(2.2) Reflexivity

Far from an analysis of language which seeks a formal relationship between an object and its representation, EM investigates the reflexive relationship between social practices and accounts of those practices. The classic formulation is that accounts are constitutive of the affairs they make accountable. Thus, it is an alternative to formal correspondence theories or representational language games. It has to do with relations of 'co-constitution,' for example, between order and local practice. Order, sense and meaning are reflexive to the practices for assembling them. According to such an understanding, every account or description is itself an action.

EM's expansion of the tradition of classic phenomenology reaches to a treatment of reflexivity as studyable phenomena, rather than a researcher's introspective method (Czyzewski, 1994; Lynch & Peyrot, 1992; Macbeth, 2000). Ethnomethodological studies suggest a research policy that treats reflexivity as context-generative phenomena of ordinary practice, rather than as self-reflection. Generally, it has to do with the phenomena that action and context are mutually dependent. It focuses on how our formulations of "what happened" become a constitutive feature of "what happened." Social events and their meaning are available as their accountability, i.e., our ways of making them observable and reportable. Thus, reflexivity in ethnomethodological studies refers to members' accounting practices, treated as unfolding in actions. We can say that accounting practices are reflexive to the situation where such a practice appears, in that the accounts which members produce are displayed endogenously in their actions, and
thus the accounting practice and the situation it renders accountable are mutually constituted.

The production of an action will always reflexively shape, elaborate or alter the circumstances in which it occurs. Borrowing an example from Heritage (1984), greeting exchanges show a simple case for examining reflexivity as phenomena. Usually, a simple rule which holds in this case is "when greeted, return the greeting." This rule makes the scene of greeting exchanges intelligible, and the scene does not remain unaltered by the next act by the recipient. For example, imagine a case in which the second greeting might be absent. Various understandings could be expected such as, for example, the recipient did not hear, the recipient did not know the greeter, failed to recognize him, snubbed, or declare a state of enmity. How the "greeting" might be hearable to members is reflexively informed by its sequential organization. That the greeting would be meaningful relies on the temporal sequence in which next acts of the recipient are embedded. In this sense, the order and meaning of actions and accounts is reflexive to the settings in which they are constituted and used.

(3) Ethnomethodological respecification of sociology's topics, including science

If for a Parsonian scheme 'the objective reality of social fact' is sociology's fundamental principle, ethnomethodology goes on to re-specify "social facts." In ethnomethodologists' terms, respecification means to describe formal objects as the activities that organize them, "in-and-as-of-the-workings-of-ordinary-society" (Garfinkel, 1991, 1996) without introducing extrinsic sources with which the social sciences render the native's activities into formal structure. Such an interest has developed social studies of contemporary professional work; e.g., law, medical, science, school (Garfinkel, 1996; Heritage, 1984; Lynch, 1993 for overall discussion of ethnomethodological studies of work and social studies of occupation). For example, Garfinkel, in his early study of

---

19 Many studies show how locally situated practices reproduce order and meaning within immanent pedagogies of local environment as in the order of a textual array (Morrison, 1981;
the Suicide Prevention Center and in his investigation of the practical organization of psychiatric records, explicates how they assemble a public image of scientific and professional rationality, even as the work of assembling them is necessarily very situationally determined. Ethnomethodological studies expand the social study of work in which mundane occupational practices are understood as self-organizing domains of recognizably competent work practices which “compose themselves through vernacular conversations and the ordinariness of embodied disciplinary activities” (Lynch, 1983, p. 208).

Ethnomethodological studies of science show a similar concern. EM studies investigate natural scientists’ and mathematicians’ everyday practices (see Bjelic and Lynch, 1991; Garfinkel et al., 1981; Livingston, 1986; Lynch, 1993; Lynch et al., 1983; which has contributed to social studies of science, see Lynch, 1993 for a discussion of EM studies of science and social studies of science). Without assuming the traditional division between the Geisteswissenschaft and Naturwissenschaften, EM studies describe scientific enterprise as thorough and thorough members’ phenomena rather than self-revelation of the nature (Lynch, 1999). As the title of one of Garfinkel et al.’s writing (1989) suggests — “Respecifying the natural sciences as discovering sciences of practical action” — the analytic task is to discover not only laws and objective phenomena associated with the Natural science but also to discover the “immanent pedagogy in

Bjelic, 1992), the apprenticeship of jazz piano (Sudnow, 1978), following instructions as the management of practical contingencies (Amerine & Bilmes, 1988), formalized instructions and situated procedure in chemical lab (Lynch, Linvingston & Garfinkel, 1983), in birdwatching (Law & Lynch, 1988), classroom as installations of knowledge and competence (Macbeth, 2000), and the formal design and situated use of a copy machine (Suchman, 1987). Such accumulated analyses provide directly or indirectly the resources for the notion of situated learning, as cognitive studies have become increasingly aware that it is impossible to differentiate cognition from actions in the world.
which members master their practice” (Lynch, 1993, p. 273-274).\textsuperscript{20}

Ethnomethodological respecification treats various categorical terms of activity which are featured in science as topics for descriptive studies. Lynch (1993) develops them as “epistopics,” e.g., the activities of measurement, observation, discovery, calculation, description, and so on. The forms of the terms are too vague to identify them as a unified method and thus the terms do not refer to a “pure” coherent activity in the social world. Rather, EM studies concern how a mathematical proof or scientific experiment is constituted through a temporally assembled texture of activities, equipment, materials and literary artifacts. The purpose of such an examination is not to develop a general model of scientific activity, or a rational model for deciding what words such as observation or discovery mean, but to understand how a general epistemic theme becomes a part of local activities. (See Coulter, 1989 for a proposal of epistemic sociology as a “praxiological approach” to social structure; see also Sharrock & Anderson, 1991 for a discussion of epistemology as the topic of describing the properties of social organization.) In other words, it aims to investigate how this or that activity could be identified as observation, discovery without assuming that such activities can be determined under a rule or definition.

For instance, Lynch’s (1991) study of measurement shows how the work of scientific measurement proceeds as a hybrid of local adequacies. For example, in one neurosciences project, days were used as an index of regenerative processes in the rat brain. Here, to align assemblages of contingent temporalities was to undertake an extensive project. There was a cost to such undertakings in time, labor, rats, and

\textsuperscript{20} For instance, Garfinkel, Lynch & Livingston (1981) have performed a study of the discovery of the “Independent Galilean Pulsa (IGP)” by two astronomers at Bell Laboratory. Their study focused on how the local process of the night’s work constitutes the discovery, and demonstrated how a scientific discovery could be understood as an endogeneous organization of the setting and its embedded practice. As mentioned above, the achievement of the scientific work of discovery is grasped in the ongoing work process in its local context.
Researchers designed the series in terms of a substantive economy, where intervals enframed the events they anticipated. In the process, 'objective' and 'indexical,' 'precise' and 'approximate' are submerged within a dense contexture of ordinary activities. 'Vulgar competencies' are unavoidable and irremediably part of measuring, because to handle lab animals and equipment is not based on scientific theory, and yet such abilities are cultivated as indispensable routines of the lab. This is not to say that scientific reasoning is the same as mundane experience, or can be reduced into it. Rather, this means that scientific reasoning can be achieved only in and through everyday practice in situ. In other words, the everyday experience, of common-sense worlds is not just a constraint on how we act and think, but a kind of practical condition in which we act and think. Everyday practice itself is endogenous in scientific enterprise, for example, as the vulgar competencies of 'preparing materials for an experiment, tuning the equipment, tracing a biochemical marker, sacrificing the animals on schedule, coding the data, taking care of noise, and plotting the data on a graph' (Lynch, 1991, p. 104).

(4) Conversation analysis and discursive interaction

The description of the contextually organized features of the classrooms requires detailed analysis of classroom interaction. Contextual practices in classrooms implicates the various forms of temporal and spatial array of actions; e.g., from individual gestural movements to whole students cohort's movements. There should be no doubt that the discursive organization of the talk between teacher and students or between students themselves is the most enduring and formative organization of classroom lessons.

This study relies on sequential analysis of classroom discourse to unpack what is contextually going on in the observed classroom lessons. Ethnomethodological studies have conducted various descriptive studies of the local production of activities in diverse settings. The different methodology forms include ethnographic description, textual demonstrations, and rigorous descriptive analysis of tape-recorded data. Systematic study of natural conversation is one of the most sustained study programs. Conversation analysis (CA) furnishes us with a way in which we can describe the sequential, discursive
production of classroom lessons. CA has found language use as a contextual practice in its own right.

CA asks about how the unfolding processes of talk in situ are sequentially available to the participants without going outside of the course of the conversation in order to reason about what has been uttered in the ongoing actions. A decontextualized viewpoint of language use assumes that the meaning of classroom talk might not be found within the given context but explicated by reference to affairs beyond the given context. For example, it is assumed that classroom talk might be understood by reference to social attributes, e.g., knowledge of the given curriculum, participants' biographical contexts, social status, power, gender, ethnicity, etc. Nonetheless, conversation in mundane local settings goes on without going outside the course of the conversation to decide what the parties mean.

In order to see the sense of ordinary activities through discursive actions, CA does not pursue a description of cognitive processes such as interactants' understanding or interpretation, but treats discourse primarily as a constructive process. Ordinary everyday activities accomplished through talk are not only constructed in order to be readily recognizable to each other, but also integral to and identical with the very practices that accomplish them. The interest of the analysis is in how people are able to organize their activities in such a way to produce mutually intelligible exchanges of utterances. This kind of knowledge people use in order to do so is a very practical one. The participants do what they do with a sense of the situations they are engaged in. The participants in settings make use of their commonsense knowledge about, and simultaneously within, the flow of situations to talk in the way they do. In CA, meaning or understanding is treated as an achievement rather than a precondition of the subsequent actions.

CA studies start from the understanding that meaning in interaction is an "ordered" accomplishment. Moreman & Sacks (1988) take the question "why do people understand one another?" and reformulate it as follows: "What forms of social organization get participants to occasions of talk to do the work of understanding the talk of others in the
very ways and at the very times at which they demonstrably do that work?" (p. 182). Common understanding is then understood as a process of interactionally ordered, sequentially organized ways of speaking, and the regular sequential structures they produce. (See Sacks, Schegloff & Jefferson, 1974; Schegloff, Jefferson & Sacks, 1977; see Heritage, 1984; Levinson, 1983 for review.)

"Turn taking" organization shows the most common feature of the orderedness of conversation; e.g., "one person talks at a time" (Sacks, Schegloff & Jefferson, 1974). A turn at talk interactionally determined over its course. For example, turn allocation tends to work like this: a current speaker constructs his turn so as to select the next speaker by direct or indirect techniques. Or if the first speaker fails to allocate the next turn, another speaker may self-select. Or if the first speaker fails to designate the next, and if there's no self-selection, the current speaker may or may not continue. That turn taking phenomena are a collaborative achievement is clearly evident in the common occurrence in actual interaction of simultaneous talk, joint construction of single sentence, and of silence (Schegloff, 1996).

A central feature of turn-taking is how consecutive utterances in interaction are linked together through "conditional relevance." Conditional relevance points to how the conversational participants' actions are prospectively and retrospectively tied to each other, and materialized through what each other says. Such a concretized feature of linked actions works as sequential environment for the development of next actions. In

Sacks and Moreman (1988) argue that "understanding" could be treated as social affair of public demonstration. They note:

[Understanding matters as a natural phenomenon in that conversational sequencing is built in such a way as to require that participants must continually, there and then — without recourse to follow up tests, mutual examination or memoirs, surprise quizzes and other ways of checking on understanding — demonstrate to one another that they understood or failed to understand the talk they are party to. (p. 185)
this way, the relevancy of actions is ordered in the sequential environment of talk exchange. In other words, the organization of interaction maximizes local control over both the distribution of turns, and what gets talked about.

The sequential order of turn allocation organizes a discursive foundation for other institutional contexts (Heritage, 1984). For instance, McHoul (1980) shows how teacher and students in classroom lesson make use of turn-allocation technique — 'current speaker selects next speaker' in order to build reflexively the social identity of teacher/student. McHoul shows how a distinguishing feature of classroom lesson talk is the teacher’s right to lead classroom practices. For instance, even a pause in teacher's explanation or instruction is a co-production by the students as well as the teacher. In this way, a teacher can accomplish her lesson without fear of an interruption at any possible completion point of her turn by the cohort of students.

CA studies focus on sequential organization as the basic building-blocks of interaction (Heritage, 1984). One such organization is of "adjacency pairs" (Schegloff & Sacks, 1973). Two utterances that stand in a relationship of 'conditional relevance' to each other constitute an adjacency pair; e.g., question-answer, greeting-greeting, offer-acceptance or apology-minimization. Upon the production of a first action, a second is due, and this is the conditional relevance of a second action upon a first. The first

---

22 McHoul (1978) points out the central difference in turn taking in classroom lessons from ordinary conversation:

(1) The potential for gap and pause is maximized
(2) The potential for overlap is minimized in that:
   (2a) the possibility of the teacher (or a student) 'opening up' the talk to a self-selecting student first starter is not accounted for
   (2b) the possibility of a student using a 'current speaker selects next' technique to select another student is no accounted for
(3) The permutability of turn-taking is minimized. (McHoul, 1978, p. 189)
speaker's production of a first pair part implies that "a second speaker should relevantly produce a second pair part which is accountably due immediately upon completion of the first" (Heritage, 1984, p. 247, emphasis in the original). The cycle of question and answer are the most familiar example of adjacency pair in classroom activities. For example:

T: What are the names of some trees?
C1: There are oaks.
C2: Apples!
T: Apple trees, yes.

(Levinson, 1979, p. 384)

On the other hand, adjacency pair phenomena are not strictly conditional; they also make possible multiple embedded sequences aimed at clarification and elaboration (Levinson, 1983). The result is that answers to later questions can precede answers to earlier ones without a loss of coherence. For example:

B: ...I ordered some paint from you uh a couple of weeks ago some vermilion
A: Yuh
B: And I wanted to order some more the name's Boyd (Request 1)
A: Yes//how many tubes would you like sir (Question 1)
B: An-U:hm (.) what's the price now eh with V.A.T. do you know eh (Question 2)
A: Er I'll just work that out for you= (Hold)
B: =Thanks (Accept) (1.0)
A: Three pound nineteen a tube sir (Answer 2)
B: Three nineteen is it= (Question 3)
A: =Yeah (Answer 3)
B: E::h (1.0) yes u:hm ((dental click)) ((in parenthetical tone)) e:h jus-justa think, that's what three nineteen That's for ths large tube isn't it (Question 4)
A: Well yeah it’s the thirty seven c.c.s (Answer 4)
B: Er, hh I’ll tell you what I’ll just eh eh ring you back I have to work out how many
I’ll need Sorry I did-wasn’t sure of the price you see (Account for no Answer 1)
A: Okay

(Levinson, 1983, p. 305)

Here, organization of adjacency pair can project an extended sequence of expected second pair parts through the first pair parts. In this example, B’s final task is to account for the absence of the Answer 1 to Question 1 which has been expected but deferred. That failure of Answer 1 effectively constitutes B’s withdrawal of Request 1, which makes A free from the obligation to respond to Request 1.

What the notion of conditional relevance makes clear is that what binds the parts of adjacency pairs together is “not a formation rule of the sort that would specify that a question must receive an answer if it is to count as well-formed discourse, but the setting up of specific expectations which have to be attended to” (Levinson, 1983, p. 306). Conditional relevance makes it possible to project that what comes next will be a response and to take retrospectively that status as a resource to how what comes next should be heard. In this way, conditional relevance is an actual criterion for the local production of actions. The overall coherence of interaction is accomplished through such local control of immediate, contingent occurrences rather than through far more prospectively designed schemes. The cognitive coherence which cognitively oriented instructional studies are looking for is a by-product of sequential organization of interaction. So, the task of analysis goes on not so much into why interaction is possible as into how interaction is possible.

CA treats conversation as an organization of interrelated social actions, and examines how those actions can be embedded in and operated through the turn taking sequence. CA has developed its own programme to specify sequential regularities and uniformities of the routine properties of talk in formal institutional settings such as medical clinics, courtrooms, classrooms as well as ordinary conversation. This literature shows the
possibility of extensive study through a rigorous analysis of the sequential organization of talk-in-interaction.

3. The field and fieldwork

This study examines how mundane classroom practice, in particular, in relation to the intended, planned features for Open Education, would appear in practical circumstances. For the examination, this study focuses on how the routine of classroom instruction appears in context through the participants’ use of practical knowledge and practical actions, and shapes the meaning, order and curriculum-in-action for the teacher and students.

The selection criteria of the study settings rely on the teacher’s perspective on Open Education. First of all, Open Education appears as a style rather than specific program or format. The discourse on Open Education often assumes that the form of the open classroom would be distinctive from that of the traditional classroom. Open Education shows a different organization which includes apparently visible formal features, e.g., less teacher’s lecture or direct teaching, increasing student’s flexible use of time and space, project works, etc. Nonetheless, what sense such a difference would make to the teacher depends upon the teacher who implements the lesson. The criteria with which we determine the setting as Open Education or traditional education thus seem to be contextual too. Thus, I could not get any definite sense of how the intended or planned features of Open Education would appear in the study settings. Instead, they were identifiable in the teachers’ beliefs, attitudes, philosophies of education, or administratively titled classrooms. Thus, I conducted participation observations in selected settings which reflected such factors.

Several settings of science classroom were chosen. The schools that served as the settings for this study are 6 classrooms in 4 different schools. Three schools (B, H, P) are located in Seoul and the other one (J) is located in a small city which is distant from
São Paulo driving. School H is private and the others are public schools. The students of the private school H come from the middle class in Seoul area. About 60 percent of the parents have a college level educational background. School H has well-facilitated conditions and the students are very active in their classroom lessons. It was observed for two weeks, mainly focusing on the 4th and the 5th grade levels, with two and three visits to each class during September-October. The teachers have had opportunities to observe the management of open style schools in foreign countries as part of their training. Many teachers and the principal of the school believe their school offers a quality education.

In contrast, school P is located in a school district whose students come from the lower class. In this school, less than 10% of the parents have college level educations. Participant observation of one classroom in the P school was conducted over eight visits, two times a week during June-September. The observation focused on the 4th grade science class. Fieldwork in P school was initiated as I joined a project in the college of education of a university for instructional innovation. The project was planned for the implementation of Open Education. The teacher has been actively involved in the project of Open Education, and was developing her master's thesis on the experimental implementation of Open Education.

School J is a public school in good condition in a local city, attached to a teachers' university. Observations were conducted in one class session in each of the 5th and 6th grade in October. The teachers are sensitive to the current reform movement, because educational policy about reform directly influences the school administration. The school administration encouraged the teachers to develop an Open style instruction. In fifth grade, they were taught about the rotation of the earth in science lab for the first part of one session and in computer lab for the latter part of the class. School B is located in a district of middle class residences in Seoul. In B school, the teacher was a graduate student of the education department of a local university. B school was observed twice in the fifth grade level classroom in September.

Usually, classes observed consist of fewer than 40 students. The number is quite
large in comparison to that of the US. It is not until recently that the classroom size has become fewer than 40. The average classroom size was over 50 a few years ago. The specific setting for this study consists of science classrooms, at the 4th, 5th, and 6th grade levels. A part of Open Education innovation is to accommodate new forms of classroom practices, e.g., by re-arranging classroom space for individualized lesson. Often, small groups of students gather face to face in their group table rather than at their desks, or in a few columns against the teacher’s platform as in the past. Or, they prepare a small space within the classroom, which is planned to be used for individual lesson time.

Usually, the class unit was scheduled for 40 minutes. However, the time for each class is relatively flexible in comparison with a traditional schedule. The flexible use of class units is to allow flexibility in classroom projects, such as the size of the task. The students’ abilities to handle the task determine the amount of time allotted for particular lessons. The most familiar form of time allocation is to combine two class-units in a single class session, which is done by the teacher’s own preference. One block may be 80 minutes, while another is 40 minutes. This was designed for having a sufficient time and encouraging student-directed activity in it.

The fieldwork was conducted from June to October, 1999. The participant observation lasted almost four months. At that time in Korea, textbook reconstruction was proceeding to prepare for the next period of the 7th National Curriculum. Thus, university researchers, publishers and administration staffs were interested in the pre-enactment of the newly constructed curriculum. In particular, the fundamental orientation of the 7th National Curriculum was to pursue the current reform of Open Education, and the organization of curriculum content was recommended to adopt the direction of Open Education. The essential concern of the project I joined was to organize the curriculum for an implementation of Open Education in schools. In school P, lesson formats were designed sometimes by the researchers and sometimes by the teachers. My task was to record the lesson scenes and report observation notes. With such a task, I got to be deeply involved in the work process. After an observation of the classroom session, I submitted an observation report which was designed to be appropriate for the format of
observation that the project required.

Most of the classroom teachers I observed were graduate students of the education department in a university whose program was well known for research and development on Open Education. Almost all of the graduate students are enthusiastic, reform-minded elementary teachers. They are eager to explore alternatives to formal instructional methods. The teacher in school P I observed was one of the graduate students in the college of education at the university. From my involvement in the research project, I gained initial access to her classroom. Afterwards, she was willing to open her classroom door for my thesis study.

My participation in the University-based research project was a great resource for discovering schools and teachers who were actively pursuing instructional innovations in the images of Open Education. Through my participation in the project, several schools and teachers were recommended to me for my thesis study. The two projects were otherwise entirely separate, and the data collection for this study was conducted after the conclusion of my project participation. The other teachers of schools B, H, J were personally contacted. They were recommended by other researchers in the field, owing to their active interest in Open Education, and the interest of the schools. The teachers do not belong to schools that are specifically titled as Open Education, but are competent teachers who are trying to implement new programs of better teaching into their ordinary classrooms. Each of the teachers studied were clearly supportive of the current atmosphere of reform.

Audio-visual records were the main field records. For this, two microphones, audio-recorder and a video camera were installed in the classroom settings or labs before the whole-classroom sessions began. In particular, the parts of the lesson sessions in the settings observed often proceeded considerably in the form of group work. In those cases, the audio-visual records focused on selected tables. Sometimes, such particular focuses were selected by teachers’ preference to particular groups. Accordingly, it was unavoidable to neglect diverse happenings in the whole classrooms, while group work was proceeding.
4. The data and the procedure of analysis

The data include 26 hours of classroom sessions. They consist of 13 video tapes and 9 audio tapes, documents and fieldwork notes, memos (including separately one video tape in School B, three in School H, two in School J, seven in School P). Transcript was made of the selected segments, after I viewed the video films over and over. From initial viewing, promising analytic themes arose and with these I viewed the tapes again. The task to identify specific segments was tedious. This work lasted until the themes were settled. In this way, the audiovisual materials were documented as transcripts which run about 90 pages.

The data primarily rely on these recorded observations during the fieldwork. Thus, the nature of the data contains what I, as a participation observer in the fields, could see and hear through recording machines. The audio-visual records particularly serve the purpose of this study. What this study has been problematizing is the routine practice in classroom lesson rather than teachers’ personal beliefs, ideas or the scenic view of the Korean way of classroom lesson including Open Education. The routine, owing to its mundane feature, is tacit for actors in situ, but it could be viewable and thus inspectable to any member who enters the classroom setting. Then, the research problem is how to access the routine.

The analysis of this study relies mainly on transcription of the recorded data. Transcription is literary genre in that what it contributes to analysis is not “real events,” but the literary analogue of the “real events.” Tape recording is mainly relied on to make transcription, as Bogen (1990) notes, “a mode of witnessing” that collapses all descriptive and mnemonic elements into an array of textual details. Another way to ‘re’produce the events is to construct a detailed scenic view, such as in an ethnographic sense. This study also makes use of the data in such a way, to give a pictured sense of the settings under examination.

The transcripts were prepared originally in Korean language, and then were translated into English. The critical problem in this procedure was how to produce followable
records for readers using English as their mother language. Above all, the most noticeably different point between Korean talk and English talk is the syntax of utterance. For Korean speakers, verbs tend to be delayed. The normative sequence of an utterance is this: Subject + Object or Compliment + Verb. Of course, everyday usages recorded in natural settings do not coincide with the normative sequence. Everyday usages proceed as deeds rather than as grammatical syntax. To extent that the translation does not intrude the flow of sequences, words have been reordered in order to be readable for English speakers.

For example, the differences in translating to English and the differences in turn structure between the two languages can be observed in turn transition space. Turn transition space here refers to "the beat that potentially follows the possible completion point of a turn" (Schegloff, Jefferson, & Sacks, 1977, p. 366). What transitional relevance space tells us is that the possible completion of a turn constitutes a point at which a next speaker may start his talk, and this requires from the both partners work which allows the projectability of each unit's end. In particular, in lesson time, it is used to organize recitations, where we can see how through a delay of the current turn, the teacher signals the next speaker's collaborative completion of the turn.

The transcription procedure this study performs follows the notational convention devised by Gail Jefferson (see Heritage, 1984). Usual conventions are as follows:

1. Brackets indicate that the positions of utterances so encased are simultaneous. The left-hand bracket marks the outset of simultaneity, the right-hand bracket indicates its resolution.

   A: [Right]
   B: [you] don't

2. Colons indicate that the immediately prior syllable is prolonged. The number of colons is an attempt to represent the length of the prolongation.

   We:::ll now

3. Equal signs are used to indicate that no gap or overlap between the turns "latched" by the marks. It means that a next speaker starts at precisely the end of a current speaker's utterance.

   What I said=
But you didn't

4. Numbers encased in parentheses indicate the seconds and tenths of seconds ensuing between speaker turns. They may also be used to indicate the duration of pauses internal to a speaker's turn.

(0.5)

5. The period encased in parentheses denotes a pause of one tenth of a second.

( )

6. Single parentheses with words in them indicate that something was heard, but the transcriber is not sure what it was.

(...)

7. Double parentheses enclose descriptions of activity, not transcribed utterances.

( ()

8. Overlap of utterances is indicated by //, placed at the point where the overlapping turn began.

9. Speaker designations:

A singles speaking is designated 'S'. Different student speakers are numbered, e.g., S1, or S2. If the transcriber is uncertain of which student is speaking, the designation (S) is used.

Transcribed segments were selected for analysis according to the emergence of the relevant themes of the study. The themes that emerged were ordered around two central organizational features of routine lesson enactments:

1. Questions with known answer. Such practice takes a very large portion of mundane classroom lessons, and shows an organization with which teachers, publicly construct the lesson and teach to the class.

2. Instructing and enacting demonstrations. Instructing and enacting demonstrations are very routinely observable practices particularly in science classrooms. Teachers craft lessons as understandable by students, and students find what the lesson promises in the course of the demonstration.

By recursively reviewing the entire 26 hours corpus of material, and by building collections of various scenes that seemed to address the general interests of the study, I reduced the corpus to a small collection of perspicuous scenes that seemed to demonstrate
the organizations of classroom questioning and science demonstrations especially well. These were also the scenes that promised to be analytically most revealing, though that judgment was made after the work of conducting tentative analyses of many more scenes than are finally presented in the thesis. Of the scenes presented in this study, each of the segments is partial. Each belongs to a larger organization of tasks and practical purposes. But each shows us something about the social organization of the respective classroom practice as it would expectably appear in a great many classrooms. The claim that they are in this sense 'representative' is thus not a scientific claim, but a practical one. It presumes that the reader will find them familiar and recognizable. Strictly speaking, of course, and as with all case studies, the cases constitute the relevant universe, and the findings are always and without exception, case specific.

The work of questions with known answers and instructing and enacting demonstrations address the larger issue of how every instructional program, regardless of innovation, will encounter these practical tasks for teachers and students alike. The organizational work they accomplish seems to be central to what is both durable and routine in classroom lessons. And there are literatures attached to each aspect of them. For the analysis, this study finds some of this related literature and then identifies in them affiliations with the reform discourse. This study makes use of them as resources with which to discuss the routine character of classroom practices. This study finds these themes ubiquitous in the classroom lessons observed, and part of the mundane organizations with which we could examine the actual situations observed in lesson time. They are central resource in the collaborative construction of action, local order, and meaning, and seem to be central to what renders student time in classroom lessons so familiar and stable. The analysis focuses on how the teacher and students together make use of the practical actions and practical sense of the flow of their way of doing lessons which craft order, knowledge, and meaning in the setting. Following the analysis, the relevancy of the data for understanding the persistence, and limits, of reform will be discussed.
CHAPTER 4

QUESTIONS WITH KNOWN ANSWERS

Among the variety of activities in classroom lessons, what we routinely observe is a form of question and answer between teacher and students. More than 80 years of classroom research has reported the persistence of question-answer recitation as a teachers’ lesson method. Researchers since Romiette Stevens’ pioneering study in 1912 have noted that nearly all are asked by teachers, and that many of them require only recitation (see Cazden, 1988; Gall, 1970; Hoetker & Ahlbrand, 1969; Wells, 1993). On actual occasions, the frequency of questioning may be far higher than the average reported in the studies which treat the coding of a teacher’s lesson behavior. Stevens (1912) complained about this:

The fact that one teacher has the ability to quiz his pupils at the rate of two or three questions a minute is a matter of comparatively slight importance; the fact that one hundred classrooms reveal the same methods in vogue is quite another matter. (p. 16)

On the other hand, classroom questioning has been treated as an essential topic in studying classroom lessons. The studies on classroom questioning represent various perspectives and interests (see, Carlsen, 1991). However, there is agreement that the most distinctive character of classroom questioning is that teachers routinely ask
questions whose answers are already in their hands, which is known by the students, and a part of the student cohort might know the answers too. The practical organization of question and answer in lesson time has been systematically treated in Mehan (1978, 1979, 1982) and characterized in other reports on question-answer-evaluation sequence (see Cazden, 1988; Wells, 1993) as e.g., “information games” (Atkinson & Delamont, 1977), “requests for display” or “test questions” (Labov and Fanschel, 1977), “information probing questions” (Levin, 1977) and “known-information questions” (Shuy and Griffin, 1978).

Studies of classroom interaction have viewed classroom questioning as a prototypical lesson structure, and they treat questioning practices as a matter of constructing the social organization of the classroom lesson wherein teachers can demonstrate lesson content (see Carlsen, 1991). They have demonstrated that such a mode of discursive practice represents as much the basic order of interaction between teacher and student as a way of revealing knowledge in the classroom. This interactional approach has pursued units of classroom practice of question and answer through an analytic interest in classroom lessons, with which they look into how each event along with classroom discourse is collaboratively constructed as a lesson structure for teacher and students alike.

In particular, studies of the social organization of natural conversation have found systematic patterned features of how phenomena of talk in interaction are outcomes of contextual activity among the participants in the setting (see Heritage, 1984), and have provided an analytic program for describing how classroom lessons proceed as interaction of question and answer. For example, the notion “adjacency pair” (Schegloff & Sacks, 1973) shows that exchange of talk between partners in interaction is ordered as first pair part and second pair part, and that the first speaker’s production of a first pair part implies that the second speaker should relevantly produce a second pair part, which is due upon completion of the first.

In this way, conversational partners recognize their talk and its relevancy in the flow of conversation, in terms of the contextual relevance of one part to the other. The IRE (Initiation-Response-Evaluation) sequence (Cazden, 1988; Mehan, 1979) in classroom

115
lessons shows such a pattern; i.e., question/answer and answer/evaluation show two-
adjacently paired turns. For students, recognizing teachers' question/evaluation and their
relevancy in producing a response is the first order of curriculum that they learn in
classroom settings, and for the teacher questions with known answers are a first-hand way
of building lessons "in a discursive way." Within such a sequence, their lessons are
crafted as orderly, and thus publicly intelligible.

Relying on systematic observation of turn taking phenomena, McHoul (1978)
illustrates how teachers make use of the discourse as in question and answer, as resources
with which to determine who should get the next turn and who should not. In mundane
classroom settings, the practical use of the turn allocation technique is enormously
dependent on teachers' rights. With this convention, teachers demonstrate their lessons
without fear of being interrupted by the conversation partner, and question and answer is
one of the most familiar turn allocation techniques used in classroom lesson time.
Questions with known answers are part of what renders classroom lessons formal.

Such a mode of speech exchange in classroom lessons provide for the practical
construction of the lesson, and from this perspective Payne and Hustler (1980) give an
explanation of how cohort-based lessons are discursively built. In general,
institutionalized contexts show their own particular interactional patterns; e.g., the
relationship between teacher-student in the classroom, doctor-patient in hospitals or
judge-convict in courtrooms is constituted in regular interactional patterns which
reflexively build the institutional context (see Drew & Heritage, 1993; Schegloff, 1987).
In the case of classrooms, such a pattern appears in the form of the two conversational
parties, i.e., the party of teacher and the multi-person party of the students as a cohort.
Payne and Hustler (1980) point out that the social identity of teacher and student is
ongoingly accomplished by the way in which they are engaged in such actions. "Acting
as a collectivity" is a taken-for-granted aspect of the collaboration in the everyday
classroom lesson (Payne & Hustler, 1980, p. 58). An individual student tends to be
treated in terms of his relevancy to the class as a whole, which is occasioned as and in the
sequential organization of questioning and answering. Much of teachers' questioning
practices serve to construct the cohort-party structure of the room, which is an effective way of organizing a lesson towards multi-persons without any time out.

Teachers' use of questioning format has also been an object of criticism from the perspective of the educators who would pursue more authentic pedagogy in school lessons, and they have criticized ordinary classroom questioning in that it reflects the formal, non-democratic feature of the institutional character of schooling. Such critique points to the limits of institutionalized practices of education, and reflects an ideal image of what authentic education should be like. For example, the critical discourse approach to the questioning practice in classroom lessons makes problematic the unequal power relationship between teachers and students in the public school, which renders the classroom lesson indoctrinatory. Young (1988) argues that formal teaching can be characterized by its 'low degree of reflexiveness,' because only teachers control the direction of talk and they seldom reflect on how this will be accepted by the students. He points out that as a result the students are expected not so much to make an independent validity judgment on the basis of their own experience, but to accept the teacher's. According to this viewpoint, teachers' use of questions with known answers could deprive students of an opportunity for their own experience of problem-solving. Young (1992) argues:

[W]hat is at stake here is problem solving learning itself. This teacher's approach to questioning not only robs the pupils of the opportunity to respond to the truth/validation claims being made, by reserving this kind of response for the teacher, it finishes up by requiring the teacher to do the learning instead of the pupil. (p. 114)

This kind of critique has contributed to the formation of reform discourses, which treat the traditional classroom discursive practices as one of their primary targets. Informed by general theoretical approaches to meaning negotiation in interaction, they have explored alternative styles of classroom discourse to create more authentic environments for children's discursive construction of meaning. This is commonly
observable in recent constructivist discussions, and these discussions often suggest that the questioning exercise should be constructed in the form of a 'dialogue' (Scott, 1998; Van Zee & Minstrell, 1997; Wertsch & Toma, 1991). For example, Wertsch (1991), by explicating the functions of teachers' talk, suggests how one could find better teaching methods. He views teachers' talk in terms of an authoritative function and a dialogue function. According to him, teachers' interventions are intended to convey information in authoritative discourse, whilst the dialogue function of teacher talk is realized as the teacher encourages students to put forward their ideas, to explore and to debate points of view. He notes: "teachers envision themselves as developing shared understanding with students through a process 'similar to negotiation' rather than 'transmitting information or confronting misconceptions'" (p. 213).

Such analyses implicitly suggest that the most important aspect of teaching is to create an atmosphere in which probing, puzzling, and raising questions provide a natural challenge to the students' present cognitive level, thereby creating the motivation necessary for changing it. For example, from the insights of social constructivist comments as mentioned above, Gallimore and Tharp (1983) design a responsive teaching model in contrast with the recitation model in which the teacher makes adjustments to support student thinking and expression of ideas, stretching them beyond where they are to the next higher level of functioning. Similar models can be seen in various efforts called scaffolding or tutoring (Wood, Bruner, & Ross, 1976), reciprocal teaching (Palincsar & Brown, 1984), instructional conversation (Tharp & Gallimore, 1988), cognitive apprenticeship (Collins, Brown, & Newman, 1989), and so on. Specific strategies recommended for developing such a classroom practice are numerous, e.g., using reflective questioning, acknowledging and encouraging students as conversation partners, invoking silence to foster student thinking, and restating student utterances in a neutral manner.

Nonetheless, we find reports which demonstrate that even when reform efforts try to enact the alternative forms of talk associated with more authentic teaching methods, the basic sequence of question-answer practices in classroom lessons coexists with them.
(Hicks, 1995; Wells, 1993). For example, Wells (1993) views the IRE sequence as an overarching form of classroom discourse, which can encompass a number of different instructional functions depending on the context. Thus, while a question which requires the recitation of a simple answer is treated as impoverished, the question of how one could un-do such a cycle of question and answer in the lesson time still remains. In other words, we have grounds to wonder why teachers find questions with known answers exercise a compelling way of enacting their lessons through which they convey the curriculum to novices or classroom children. Earlier, Hoetker and Ahlbrand (1969) directly address the question regarding the problematic persistence of question-answer recitation:

What is there about the recitation, for instance, that makes it so singularly successful in the evolutionary struggle with other, more highly recommended, methods? That is, what survival needs of teachers are met uniquely by the recitation? (p. 163)

These questions can be raised as well in the classrooms this study observed. Actual occasions wherein teachers and students build sequences of question and answer vary. To an extent, the variety of the occasions depends on heterogeneous settings and the contingencies of the participants' use of the practical common understanding of their tasks. Such occasions show various ways in which the participants in the lessons make use of practical actions and have a practical sense of what they do, while they are routinely working within the familiar question and answer sequences. By suspending judgment as to whether or not such occasions could be desirable, it could be useful to examine actual cases concerning how they could shape curricular activities for teacher and students together.
1. Revealing answers in collective actions — A case of cohort-based instruction

Usually, the two-party structure is a constituent part of classroom practice. The following scenes demonstrate how the practice of the routine of questions with known answers proceeds not so much as a matter of a test of knowledge, which is typically assumed to be the main function of questions with known answers, but as a matter of social organization wherein the teacher can enact cohort-based instruction. They show how the teacher enacts cohort-based instruction through ordinary practices such as the IRE sequences, without time-out.

The following scene comes from observation of a 4th grade science lesson in H school. H school is a private school in Seoul. The first impression of the class for me was that the students were very active in expressing themselves, which might presumably be a result of their backgrounds. In a well-organized school lab, they were being taught a lesson on electric circuits and the nature of the electric flow. The procedure of this lesson was that first, the students would learn to represent the electric circuit in a diagram. Second, they would read a diagram of the electric circuit, and then anticipate whether the circuit it represents would work. Third, they would build the electric circuit that the diagram represented, and identify their anticipated results.

This scene shows the second step. The teacher was arranging the prepared diagrams of electric circuits. The diagrams were of the circuits they would use to conduct the day’s experiment after this procedure. The teacher asked the students questions about the nature of the circuit. The questions were posed in anticipation of the later experiment to be done by group activity. Putting the prepared drawings of diagrams on the blackboard one by one, the teacher asked the students questions.

1. T: Are you ready?
2. S: Yes.
3. T: We promised we just keep silent.
4. S: Yes.
5. T: We’re just gonna tell what we predict.
7. (0.5)
8. T: Let's see.
9. T: Hojae!
10. Now we got one bulb and two batteries here, right?
11. I'm asking Hojae. Listen carefully, the rest of you!
12. Are these batteries, right now, connected in a series, or parallel?
13. Tell me!
14. The others (keep quiet.)
15. H: The battery...
16. T: What?
17. H: The battery is a series...
18. T: //OK, I wanna see how much you understand of
19. what we studied last time,
20. It's about whether the batteries are connected in a series or parallel.
21. H: I think the bulb...
22. T: No, I mean the battery.
23. H: The battery is (1.0)
24. T: You are not sure, right? Are they connected
25. in a series? = ((turning his face to other students))
26. S: = [Yes]
27. [No]
28. (0.5)
29. T: No?
30. S: Yes.
31. T: Who thinks it is a series?
32. (0.5)
33. In a series.
34. Who thinks it is a parallel?
35. (0.5)
36. We have some who think it is a series and others
37. think it is a parallel.
38. OK, let's go ahead and check it out.
39. Watch this, the line goes towards this bulb, this bulb.
40. See. This is in a line like this.
41. We've learned electricity flows from plus to minus in the last class,
42. not separate from here.
43. Then, is this circuit a series or parallel?
44. Why doesn't somebody tell me? (.)
45. Yo, tell me, what is this?
46. Yo: The battery is connected in a series.
47. T: //It's connected in a series.

This scene begins as the teacher gazes around the class in order to ask the question by
designating one student among the cohort as the next speaker. The teacher designates the
answerer, Hojae, and then asks the question. As usual, by doing so, the teacher
effectively finds a way to demonstrate his lesson without having to ask the question of the
students one by one. The teacher gives a caution to the rest of the cohort not to respond
to the question. Right now, Hojae is the one in the room who is to respond to the question as a representative of the cohort. Then the teacher asks a question which requires an answer in the form of a binary choice.

12. Are these batteries, right now, connected in a series, or parallel?
13. Tell me!
14. The others (keep quiet.)
15.H: The battery...
16.T: What?
17.H: The battery is a series...
18.T: //OK, I wanna see how much you could understand of
19. what we studied last time,
20. It’s about whether the batteries are connected in a series or parallel.
21.H: I think the bulb...
22.T: No, I mean the battery.
23.H: The battery is (1.0)
24.T: You are not sure, right? Are they connected
25. in a series?=(turning his face to other students))

The teacher asks the question, and Hojae hesitates in line 15. Then the teacher interrupts with “What?” Hojae goes on to reformulate the answer, but he still murmurs. The teacher overlaps his answer. It is the third turn to the sequence, which routinely appears as an evaluation, but it is not an evaluation this time. Rather, the teacher can see that Hojae is having difficulty with the question. He withholds an evaluation of the answer given in line 17. Instead, the teacher reformulates his talk, making use of the local knowledge of the room in line18-19 [rather than a test, I just want to know how much you understand of what we did last time. If you are one of those who attended the last classroom lesson, you will know about it].

The teacher’s way of proceeding has two senses in this context. First, the teacher tells them that the demonstration is a demonstration of their lesson. Thus, the demonstration
refers to their lesson, and the students' task is to find the 'relevance' of their lesson to the demonstration. We could say that the demonstration is to be the 'enactment' of their lesson rather than a test of knowledge. (See Macbeth, 2000 on the relation of demonstrations to what they demonstrate.) Second, the teacher virtually starts the question sequence all over again, as seen in line 20. He frames it once again, and in doing so it is predictable that he will pose the question once again. In fact, he reformulates the question in line 20, and invites Hojae to produce a response again.

What Hojae then does is to try to answer the prior question. In 21, Hojae begins to talk again, and he changes the form of his answer at this time. But he confuses the 'bulb' with the battery as the object of the question, which then is immediately repaired by the teacher in line 22. Then he tries again in line 23, initiating the answer by correcting the response of his prior turn, but a pause ensues. In the pause, he gives public evidence of his difficulties. Then, the evident demonstration of his difficulties becomes an object for a direct remark by the teacher in line 24, i.e., Hojae's uncertainty. Such sequences may be useful to let the teacher know what students are uncertain about.

If one were complaining about the sequence, saying that it is not authentic 'enough' they would basically have to be arguing for some kind of naive induction, as if the students could figure out whether it is in series or in parallel on their own. Given the kind of curriculum this is, with canonical knowledge attached, that the answer could be known in advance is not just some privileging of the teacher. Rather, for this kind of knowledge, the answer really is known in advance, but this rarely tells about what the students are going to do in the context. For it is a matter of interpretation in which the students have

---

23 Usually, in conversation a speaker addresses his understanding of the prior talk in every next utterance. By doing so, he also reveals what he finds problematic, i.e., misunderstanding. Studies of conversation analysis articulate such a phenomenon analytically in terms of "organization of repair" (Schegloff et al., 1977), which shows an organization of talk and other conduct by which participants can deal with problems or trouble in speaking, hearing, or understanding the talk (Schegloff, 1979, 1991, 1992).
to read diagrams and decide what the demonstration is showing them in the discourse. It is part of the distinctive kind of curriculum we find in classroom lessons.

24. T: You are not sure, right? Is it
25. connected in a series? = (turning his face to other students)
26. S: = [Yes]
27. [No]
28. (0.5)
29. T: No?
30. S: Yes.

In line 24–25, the teacher turns his face to the others and repeats the question. At this time, the question goes from Hojae to the cohort. By doing this, the teacher makes use of a third turn as another initiation of question, as the teacher reformulates the question but in a different form; the question has become a more closed question. The form of the question requires a yes/no response, calling for agreement or disagreement with what Hojae has answered. The other students are monitoring Hojae’s response and the teacher’s reallocation of the question, and then are competitively calling out answers. Here, the question receives both “yes and no” simultaneously.

After a short pause, the next turn is taken by the teacher. Of the two different answers given, the teacher selects one, and then replies to the answer by repeating it as a question: “No?” His selection of the latter response among the students’ responses suggests that the teacher is making use of the previous answer in order to demonstrate a negative evaluation of the prior response. The pitch of the talk uttered by the teacher, “No?” gets high at the end of the utterance in line 29. After delaying the response, the teacher says “No?” upon which then the students immediately respond “Yes.” The negative evaluation is projectable for the students given how they could hear the teacher’s response in the third turn after production of their two binary responses and the teacher’s selection of one of them, following short pause. The analysis of turn-transition in natural
conversation reports that dis-preferred third turns are usually delayed, and with the delay the conversation partner immediately perceives that something has been heard as wrong by the other partner.

Repetition of the prior response occasions a next place for the partners to produce a correction of his/her prior response. The students hear his ‘No?’ as an evaluation because they know how lessons work. In other words, that it sounds apparently skeptical of the prior turn is an achievement of the cohort’s sense of how IRE sequences work. Using such a question form, the teacher checks to see if there is anyone else among the cohort who needs to be taught a few features of the lesson.

31. T: Who thinks it is a series?
32.  (0.5)
33.  In a series.
34.  Who thinks it is a parallel?
35.  (0.5)
36.  We have some who think it is a series and others
37.  think it is a parallel.
38.  OK, let’s go ahead and check it out.
39.  Watch this, the line goes towards this bulb, this bulb.
40.  See. This is in a line like this.
41.  We learned electric flows from plus to minus in the last class,
42.  not separate from here.
43.  Then, is this circuit a series or parallel?

---

24 The analysis of conversation structure has found a “preference” organization across the adjacently paired turns (see Levinson, 1983; Pomerantz, 1978). Preference in interaction tends to be towards acceptance more than refusal, agreement more than disagreement to the opinion or suggestion, and dis-preferred next turns are routinely marked with a delay in their production. In the classroom, a teachers’ third turn that produces negative evaluations of student answers is also routinely delayed in its production.
Again, once the teacher identifies uncertainty throughout the room as he goes to the next phase unfolding in two successive phases. First, the teacher shifts the target of his question from a single student to the entire cohort. By doing so, he checks what the cohort needs to be taught. The teacher’s question has been asked to check if there is agreement on Hojae’s answer among the cohort. At the same time, the question shifts into a form of “who thinks” this or who thinks that, as observed in line 31-37. The cohort knows that this question requires them to raise their hands rather than individually answer. It is a technique to reveal locally relevant categories into which the cohort is divided. It is a technique in that with this strategy the teacher can effectively and publicly assess the cohort at a glance without needing to ask questions one by one.

Second, the teacher begins the task of relating the lesson to the demonstration. Rather than asking them, he is showing them, and what he needs to show them was only discovered over the course of asking them the kinds of questions seen in lines 38-42. The demonstration becomes a way to explicitly relate the lesson to the display, and it is done as a public matter for everyone in the room to see. Then, in line 43, the teacher posits the question which has been alive through the sequence since the initial question in line 12. And when gets the answer in line 46, and he offers a confirmation of it in line 47. In this way, the question in line 12 is resolved.

As seen, the IRE structure is quite useful for revealing what the instructional needs are among the cohort. Whatever instructional innovation we can imagine, it will have to find a way to do the work of making assessments of what the students know of their lessons, in real time. The IRE structures are social organizations for enacting lessons of cohort-based instruction, and that task will be confronted by every next instructional reform. The teacher makes use of the sequence in order to enact the lesson towards the
students as a cohort. The answer is in the teacher's hand and possibly some of the cohort have it. By making use of such facts, the teacher explores how he can enact the lesson for the students as a cohort. That the teacher does so is not new; rather it is part of his, and the students' commonsense knowledge about the organization of classroom lessons. Nonetheless, without them we do not know how the teacher could implement the lesson in the classroom where he has to deal with multiple persons as students. The following sequence is from the same class:

82. T: Let's see the third one. The third one: is this. (1.0)
83. The third one (here), now, watch this. (2.0)
84. Who can tell me about the connection of the bulbs from this?
85. what kind of connection? Jeon.
86. J: Parallel.
87. T: Is this parallel? Is there anyone who thinks differently?
88. ( ): No.
89. T: The bulbs are connected in parallel.
90. How about the batteries?
91. S: Series.
92. T: You'd better raise your hand to say something, because there
93. might be someone else who would think differently. (.)
94. Kim!
95. K: Series.
96. T: You mean it's a series?
97. (…) 
98. OK, these are, the bulbs are parallel, the batteries are series.=

In line 87, the teacher repeats the response of line 86 instead of offering an evaluation of it. By doing so, he uses the cohort to make the third turn assessments, having them agree or disagree with the answers provided. He then got a response with which the students show agreement. A similar pattern of the sequence takes place in line 90-98. In
this sequence, the teacher again makes use of the questions to the cohort as a test of them. This time, with the answer of line 91 in hand, the teacher uses a kind of 'false skepticism' in lines 92-93. But agreement is found, in line 95, and in that sense they all 'pass the test.' Having discovered what they did not know, and having produced an effective demonstration of what they needed to know, the teacher has demonstrable evidence that they 'got' it. Central to doing all this is the order of questions with known answers used within a cohort-based organization of instruction.

Questions with known answers are thus not simply 'test questions.' They are a way of enacting the lesson by revealing what features need to be taught and learned. They are a way of assessing the instructional needs of the cohort 'without time-out.' That is, the teachers do so without going out of the sequential flow of the IRE in order to check the cohort. The cohort-based instruction of questions with known answers is done as the very order of the discourse and relies on the fact that the students have already learned how this kind of 'language game' works.

Teachers routinely ask questions with known answers of an individual student as well as the whole cohort, but the flow of the sequence invariably serves to build cohort-based instruction. The two-party structure of classroom lessons, therefore, is still viewable in collective action centered around sequences of question and answer. This takes place through collaborative work, in which a procedural sense and practical actions from the students in the setting are required. Arriving at the answer to the question is built upon the two parties' common sense of the flow of question and answer. Questions with known answers are not just about a test of 'knowledge.' They are about the social organization wherein the teacher enacts cohort-based instruction, and they are the social organization for enacting lessons for novice students. And those tasks will be confronted by every new instructional reform.
2. The third turn evaluation

The role of the third turn evaluation in the IRE is crucial to lessons. Conventionally, one of the particular merits of this feature is to have a built-in repair structure in the teacher's last turn so that incorrect information can be replaced with the right answers. By doing this, teachers make sure that their lesson is accessible for the students. The third turn acts as a "gatekeeper for the lesson" (Griffin & Humphrey, 1978). In practice, the third turn evaluation takes place within the social organization of the questioning sequence, and preference organization is one of the most distinctive social organizations that work in the construction of the third turn evaluation.

Systematic studies on conversation show that the work between adjacent turns such as the second and third turn in the IRE is as much a matter of the social organization of interaction as of the interactants' personal preference or the related topic of the lesson (see Pomerantz, 1978). They indicate that a positive evaluation is routinely produced on time, but when the answer is negatively accepted, the evaluation of it tends to be delayed. It is within such social organization that teachers get the students to see what the lesson demonstrates through the IRE sequence.

On the other hand, that teachers routinely measure the adequacy of students' second turn of response, a confirmation of which appears in the third turn evaluation, is also a target of the critique of the asymmetrical power relationship between teacher and student. Such an asymmetrical relationship has to do with the larger social organization as a locus of the determination of adequacy. For example, Young (1988) argues that the structure of the formal classroom lesson is indoctrinatory in that:

at the surface level the speech purports to be consultation with the students about their opinions, views, etc., but at another, deeper level, the teacher's agenda controls the direction of talk and inclusion and exclusion of clues along the way to the lesson's (predecided) conclusion. (p. 57)
The concern of this critique is that only teachers own the right of controlling the situation and thus they do not permit an opportunity for students to initiate their own topics. It is argued that this could diminish the possibility of two-directional communication between teacher and student. The critiques of the teachers’ authority have been reflected in reform discourses, and they have explored alternative teaching methods to replace the routine way of offering an evaluation of students' responses in classroom lessons.

Nonetheless, we wonder to what extent teachers could find an alternative way of enacting their lesson when they are involved in minimal environments between the second turn space and the third turn space in the question-answer sequence. In particular, we could puzzle about the intent of such reforms, when we observe actual occasions where the teacher’s third turn serves the continuation of the lesson, instead of its end point. Such a problem needs to be considered in a close examination of actual cases. The following scenes show how the third turn is constructed in the flow of the sequence, and in doing so how the teachers are carrying out the lessons. These examples will provide a different picture of what teachers actually do in such sequences, and suggest one of the possible reasons why such practices are so persistent, if they are.

In the fourth grade classroom in school P, the students are being taught about the ecology of mold.

1. T: It is a parasite. Parasite.
2. But it is a kind of plant::
3. We can name great duckweed or (...) as a plant, right?
4. What color does the plant usually have?
5. S: Green= 
6. T: =It may be green, but how about mold? What color?
7. S: //Various colors
8. S: Various colors
9. T: // (various colors)
10. Then, is it really a plant?
11. S: No.
12.T: It isn't a plant?
13. Is it a microorganism?
14. The mold is a plant.
15. (2.0)
16. Isn't it?
17. (4.0)
18.S: (It's a microorganism)
19.T: It is?
20. (2.0)
21. The mold, we can call it like a parasite,
22. which lives on others...
23. They have no green color like that. So it is not easy for you, but,
24. they can't feed themselves. It is a kind of plant,
25. but it is a parasite.

In lines 1-2, she introduces two categories that are relevant to mold: 'Parasite' and 'kind of plant.' In line 3, she names a 'typical' plant, and then invokes color as a feature that 'goes along' with plants. The students answer in line 5, and then she confirms the answer in line 6. We've just seen a typical IRE sequence. However, the very typicality of the 'greenuess of plants' is then used to problematize what she has just said in line 2-that molds are a 'kind of plant.' She does so with the next IRE sequence about the color of molds.

10. Then, is it really a plant?
11.S: No.
12.T: It isn't a plant?
13. Is it a microorganism?
14. The mold is a plant.
15. (2.0)
16. Isn't it?
17. (4.0)
18. S: (It's a microorganism)
19. T: It is?
20. (2.0)

In line 10, she asks if it is really a plant. It is also a question about her formulation which has been addressed in line 2. With this, she has both told them that it is, and then given them grounds to think that it might not be. This is partly 'propositional' knowledge [plants are green, and molds are brown; therefore molds are not plants]. Nonetheless, it is further developed discursively in the form of initiation of her next question: Is it 'really' a plant? The way the question is posed invites the answer 'no' [it may be a 'kind' of plant, but it isn't really a plant].

Line 10 is an Initiation, and line 11 is a Response. But line 12 is not an evaluation directly. Rather, in delaying an evaluation -- by asking a question -- the question in line 12 is then heard as projectable for a negative evaluation. So, we could anticipate that the students would hear, given the sequential organization of the IRE, that it is a plant. And in this sequence, we could say that such a hearing is entirely a matter of hearing sequential organization, rather than 'propositional' knowledge. This is the work of 3rd turns. That is, the students hear the adequacy of the answer in the organization of the interactional sequence.

The teacher then introduces a new possibility -- at least new in the sequence; they may have discussed this before -- that it may be a 'microorganism.' This is yet another categorical possibility. She continues her turn without waiting for the cohort's response, producing another question in line 13. Then, in line 14 the teacher states, ["The mold is a plant."] In this sequence, this could be heard as a response to the question. But the teacher does not complete her question by making this statement. Rather, it reflexively informs students that the teacher is extending the question, even though she does not make her response in the form of a question. She holds her talk, and there is a pause in line 15. It is a possible space for the students to interrupt, but there is no talk from the party of the cohort.
In the normal pattern, a pause after a prior declaration by the teacher could be assumed to be a 'wait-time' where the teacher expects something is produced from students as a response to her question. The pause and then such an utterance as that after line 16 reflexively inform the cohort that she might have been waiting for the students' response after the utterance in line 14. Otherwise, she might be looking for the next action, simultaneously searching for appropriate words for that place and measuring their adequacy. Thus, even though her reformulation does not take the form of question or command, the students might be hearing her reformulation as a question, or invitation. The students could hear pauses as an end of the prior turn, but it does not seem to be the case here. It is the turn transition place between first and second turns which provides the students with a space to take the next turn. Again, the teacher uses a tag question in line 16, asking a question which requires affirmation or negation from the students. Then, in

25 Question-pause or address-pause is quite a common feature of the question and answer sequence in classroom lessons. There could be several explications of why such pauses are made. One of the possible explanations is the relevance of a pause in extending wait time to give the student time to think. The process-product perspective of "wait-time" concerns a correlation between a pause after the teacher's question and an increase in the number and length of the student’s utterances (see Fagan, et al., 1981; Honea, 1982; Swift & Gooding, 1983; Tobin, 1986). According to this perspective, one of the strategies for open-ended questioning is to extend wait time, which is expected to have an effect on students' more verbal participation in class. Tobin (1986) notes such a case as follows:

The pause between teacher utterances provides students with an opportunity to consider what has been said and to assimilate new knowledge with previously learned information. The pauses that follow student discourse can be used by students to consider what has been said and to formulate a reaction, question, or alternative response. From the speaker's perspective, the pause might represent an opportunity to reflect on what has been said and to consider what to say next. That is, the pause provides a speaker with an opportunity to think. (Tobin, 1986, p. 192)
line 17, she holds her talk again, for a noticeably long time.

Then, in line 18, someone among the cohort in the classroom breaks the silence and produces the answer. He seems to make use of the new categorical possibility of 'microorganism.' We could say that the student is avoiding the binary choice that the teacher has now presented 3 times [in lines 10, 12, and 16, i.e., is a plant vs. is not a plant]. But more importantly, the response of line 18 is also an answer to the question of line 10. Line 10 initiated the main Q/A sequence, in which these other turns are embedded. If line 18 is a response, what is line 19? It shows another projectable but delayed evaluation, using the same question seen in line 12. It is a question in an evaluation place, and is routinely heard as projectable for a negative evaluation. However, it is also a question, calling for an answer. But instead of an answer, it gets a [2.0] pause.

Then, in line 21, the teacher continues, and returns to the category of 'parasite' mentioned in line 1, but not since then. As it turns out, that is the 'known answer.' Here, the answer was not simply 'known' by the teacher in advance. She actually gave the answer in line 1. We could say that the answer was publicly acknowledged in the room all along. Nonetheless, the relevant demonstration here is less that the answer is known in advance, but how the teacher makes use of the known answer to build an account of it. She is taking the known answer, even giving it to them, and then embedding it in other contingencies of their lesson, thereby giving students the task of 'retrieving it' from other possible relevancies. She thus 'places' the known answer within an array of other features of their lesson, and gives students the task of 'retrieving it.' In doing so, she 'accounts' for the various features she introduced along the way [the relevance of 'green,' and that it is a 'kind of plant'], acknowledges that it has been difficult for them (line 23), and concludes, ["But it is a parasite"] (line 25).

For that kind of work, the relevancy of the sequential organization of the IREs is the principal resource, for students and teachers alike. The adequacy of the second turn response is in the teacher's hand. Nonetheless, for the teacher, how to get the students to understand the lesson is a practical task when enacting the lesson. Here, the teacher
demonstrates the lesson through Q/A, which is achieved in discursively built local environments. The fact that the teacher holds power over the students in deciding the relevancy of the lesson hardly suggests us that the teacher does not have to enact further lessons regarding the topic anymore, or that we should treat such practices in the third turn as problems that should be overcome. Moreover, if it is so that the teacher routinely makes use of the known answer as a resource with which he/she can enact further lessons, the actual adequacy of question-answer in the exchange is itself interactionally produced and organized.

The following scene is the series/parallel circuit lesson in H school. It provides another occasion of how the teacher makes use of the third turn in order to get the students to see and speak of the lesson in a particular way.

57. T: Let's see, Hyunjae Park! Is there anything different in the second one compared to the first one, yes or no?
58. H: Yes.
59. T: It looks similar to me.
60. S: //Yes, yes.
61. T: OK, Hyunjae. What's the difference?
62. H: In number 1, the parts of plus and minus are mixed.
63. T: In number 2, plus in the same direction.
64. T: There is?
65. H: Yes.
66. (H): Yes.
67. T: Then, what kind of connection is this?
68. (0.5)
69. ( ): Series.
70. T: Who can tell me about this?
71. (0.5)
72. (0.5)
73. Can't you see that?
74. Yo, what can you tell me about this?
75. Yo: The batteries are separately (connected.)
76. T: Separately.
77. Yo: (In a parallel.)=
78. T: =In a parallel. Aha, so, in a parallel, in a parallel::;
79. OK::: Let's skip for a moment:::, in a parallel:::
80. S: Hahaha.
81. (0.5)

In lines 57-58, the teacher has asked to Hyunjae a question which requires as its response yes/no, and it gets the answer “yes” (line 59). In the next turn, the teacher offers a response to the answer. The teacher’s third turn is a place of evaluation of Hyunjae’s answer. However, the teacher produces it in a way that does not show a strict evaluation or negation of the answer. Rather the teacher responds to the answer in a hearably “guessing” tone. The students, however, hear it in the way that there’s something negative in the teacher’s response, and thus they immediately speak out [“Yes, yes”], before the teacher finishes the response. In doing so, the teacher’s ‘negative’ evaluation in line 60 may be another ‘test’ of the cohort’s certainty – a false skepticism – and the students in line 61 recognize it that way.

And then the teacher is accepting the bid for the turn [“OK”] in line 62, which also works as a third turn evaluation of Hyunjae’s answer. And then without pause, he continues to ask a question to Hyunjae. The teacher asks the question in a way of specifying the answer received from the cohort including Hyunjae. Here, the response in line 62 [“OK”] is used as a punctuation with which he continues to ask a further question.

In line 62 the teacher asks the question, and Hyunjae responds to it in lines 63-64. In line 65, the teacher produces third turn position rather than evaluation, which calls for Hyunjae to confirm his answer. In line 67 the teacher poses a different question, which shows he does not give an evaluation in this place but calls for naming the difference. Without offering the evaluation of Hojae’s answer, the teacher asks a new question, taking the student’s response as a resource to continue his questions. Then, there is a
pause, with no response. In line 69, a student produces an answer without being
designated by the teacher, but it is not taken by the teacher. In lines 70-73, repeating the
question, he is looking for a candidate of the answerer. The teacher asks the question
again. In line 74 the teacher designates a student, Yo. In line 75, Yo responds to the
question with a plain term ["separately"], and in line 76 the teacher identifies the plain
term. Yo repairs it, changing it into a scientific term. In line 78, the teacher latches into
the response, and repeats Yo's response several times, in a display of strong positive
evaluation.

The teacher keeps repeating the student's response with prolongation. He is trying to
get the students to recognize how the batteries are literally connected -- get them to see
and say it that way. Making use of the Yo's response in line 75 for the purpose at hand --
getting the cohort to see and speak in a way that he shows the lesson, he enacts the lesson
in *ad hoc* way of immediately finding relevance of next actions within practical, local
circumstances of exchange of question and answer, i.e., within the social organization of
the IRE.

Similarly, in the same class, the following scene shows the continuing effort of the
teacher to get the class to correctly identify, in the appropriate language of the lesson, and
the kind of connection they are seeing.

108. T: Is there anybody who can compare the third one with the fourth?
109.  (1.0)
110.  Over there, Sangjin!
111. SA: In the third one, the battery is connected (...)
112.  forth one, (...)=
113. T: =So, what connection is this?
114.  (0.5)
115. SA: Series.
116. T: Series, and how about this?
117. SA: Parallel.
118. T: Parallel or not, the connection is, this isn't a parallel, right?
119. T: Is this a parallel?
120. S: (No, series.)
121. T: //OK, we don’t know yet if it is parallel or not. Anyway,
122. let’s see if it lights or not, later.

In this scene, the teacher poses a question about a comparison between the third diagram and the fourth one on the blackboard. And then he designates one of the cohort, Sangjin, to answer. In line 113, the teacher immediately produces a new question. He does so without offering an evaluation of the Sangjin’s answers in lines 111-112. By doing so, the teacher goes on to the next phase of what the lesson demonstrates, and this means that Sangjin’s answer has passed the teacher’s first question. Then, in line 115 the newly posed question gets an answer from Sangjin. The teacher repeats the answer and then goes on to pose another question. Sangjin produces an answer [“parallel”].

In line 118, the teacher offers a third turn evaluation. At this time, he produces a negative evaluation of the prior response, with a tag question. Then, in line 119 the students confirm what the teacher says. Again in line 120, making use of the answer that Sangjin produced, the teacher asks a question again. In this way, the teacher works from Sangjin’s answer in line 117; though negatively evaluated, it is a continuing resource for the lesson. He continues, posing the question as seen in line 120. With this, the teacher might want to check the cohort in order to tell who is going to say ‘yes’ or ‘no.’

Then, the teacher does not wait for the students’ response. Instead of addressing the answer of the question in the prior turn, the teacher formulates how they will check the answer according to later work. Such a formulation is not just done in order to decide the correctness of their answers. Rather, with this, he closes the current cycle of the question and answer, and goes on to the next phase. The participants in the room know the teacher knows the answer and it, in addition, has already been revealed.

The fact that the teacher already knows the answer is not a privilege for him in enacting lessons. And the fact that he holds the adequacy of the answer does not provide for the
teacher a resource to control the way of how he exchanges question and answer with the cohort. A primary concern for the teacher is how many students among the cohort need to know it and how to teach it to the cohort. The teacher does so in the ongoing lesson activity -- the IRE sequence, here -- without going out of the sequence in order to find how he/she could connect the third turn evaluation of the students' response with what the lesson is going to demonstrate.

Rather, the teacher and the students find the adequacy of their question and answer in the course of interaction, in the ad hoc way that the teacher's follow-up questions rely on students' answers to first questions. How the adequacy of an answer becomes known to the teacher, and to the cohort, is an accomplished feature of the occasions and activities within them which they are involved.

If we look closely into how the teachers make use of the third turn evaluation, we can see how a lesson is organized in a way to get the students to find what the lesson promises. And if we attend to the social organization of the occasions whose adequacy is built only in interaction, we could find that how the teacher produces the third turn evaluation is more than a matter of the institutional constraint of the schooling, i.e., asymmetrical power relationship that is assumed to appear in the IRE sequence. If the IRE sequences persists regardless of whether it is built based upon the inequality of the power that the teacher possesses in her professional status, we could puzzle about how the exchange of question and answer between teacher and student could usefully be an object of reform. We would first need to understand the practical, and durable work that such exchange performs.

3. Higher-order questions within the local order of lessons

Why-questions are a recurrent form of teacher's questioning. In general, why-questions do not permit the form of yes/no answers. It is assumed that why-questions are designed to get students involved in more than recitation, i.e., to reflectively think about
what they have studied. It also has the purpose of enabling students to move from mere factual recall to generalizations, and inferences about the relationships of the topic to current situations. Such an attitude is commonly shared among teachers and researchers, as Hammersley and Woods (1986) observed:

[V]irtually the whole tradition of research on teacher’s questions is based on the assumption that inference-type questions generate more effective learning than do recall questions, and this assumption is also found in the range of manuals that have been published for teachers about how to ask questions. (Hammersley and Woods, 1986, p. 89, cited in Edwards and Mercer, 1987, p. 31)

Theoretical discussions regarding teaching and learning have supported the search for desirable methods of transmitting subject knowledge, and many models of how teachers could make use of alternative ways of questioning in the actual lesson situation are proposed. For example, Eisner (1998) has generalized a model of a good question-asking strategy through his observation of a case wherein the teacher made use of the higher-order type strategy, as viewed by him. According to Eisner, in lesson time, why-questions come after a form of yes/no question, and then a form of what-question, if the answer to the prior questions is successful. And if not, the question goes back to the forms of the prior ones. With this, he expects the production of an effective question asking sequence which could serve to elicit students’ higher-order inferences.

While researchers and educators try to develop alternative practices of question-answer for classroom lessons on the one hand, on the other hand there are problems regarding how teachers could enact alternative models of questions in the actual field of the classroom lesson, and to what extent one could tell such a form of question-answer from typical question-answer recitation. For example, while Eisner (1998) suggests it is intended that higher order questions will get students to produce more sophisticated responses about the lesson, he also notes that just how why-question have to do with enhancement of the answerer’s understanding of the related curriculum remains
ambiguous. He asks "How do we know that students extend themselves to their next level of proximal development when higher-order questions are used?" (p. 148).

As a matter of fact, when we turn to research on the coherence between the cognitive level of teacher questions and the cognitive level of student oral responses, we find that it provides little evidence of correspondence (Dillon, 1982; Mills, Rice, Berliner, & Rousseau, 1980). A question can be raised regarding how one could tell higher-order questions from the routine way of using a questioning sequence in classroom lessons. Especially if the latter can be shown to exhibit in any form questions with the intention to elicit higher order thinking from students.

The following scene is from a small group instruction time in P school. On a table which has been prepared in a corner of the room, there are materials, wires, bulbs, batteries, etc. The teacher and four students are constructing electric circuits, and their task at hand is to light up the bulb and then demonstrate their understanding of the principle that causes the circuit to work. Two students make one set of circuits. The teacher, sitting by the table, gives them instructions and watches over their manipulation of the materials and equipment. When the students have almost completed construction of the circuits, the teacher begins to ask questions about the set of circuit and the nature of electricity. She initiates her questioning with a why-question and gets an answer from the students. She then continues her questioning with why-questions.

54. T: Let’s see the connection. Let’s see the connection.
55. We have two with the same connections to the bulb, here.
56. You both have some telepathy with each other. (...)
57. What kind connection do you think these are?
58. S: A series circuit.
59. T: A series circuit?
60. Why do you think it is a series?
61. S1: These are connected with each other, and ...
62. T: =Don’t think about the battery. Just think about the bulb.
63. How, why is this a series?
64. S2: Because this battery is connected here to the switch like this.
65. T: Is this a series because it is connected with the switch?
66. (The teacher turns on the switch of one circuit to check whether it works)
67. S2: Huh? What happened? ((giving attention to the circuit, S2 finds something wrong with it))
68. T: You have the same circuits here, this kind of connection [...}
69. S1: The wire is connected in a line.
70. T: How about the opinion that the wires are connected in a line?
71. How about others?
72. Jun!
73. S2: Yes?
74. T: He says it is a series because the wires are connected in a line.
75. S2: Yes.
76. T: What do you think?
77. (0.5)
78. S2: That's good.
80. S4: Hehh.
81. T: How about Soyoung?
82. (0.5)
83. S3: The wires connect one by one.
84. T: It means the wires connect one by one?
85. If so, why don't you pull this off?
86. Why don't you pull off this wire?
87. Let's see if it'll make it light up.
88. What happens?
89. (0.5) (...)
90. You connect the bulb with wire,
91. Now, that consists of one wire.
92. Let's change the position in order to tell easily,
93. (1.0)
94. in order to tell at a glance that the bulb is connected in a line.
95. Just one, Hyoung's, let this one alone, just one.
96. S1: Shall we put on the switch? ((Very faintly))
97. T: Eum?
98. S1: We take out the switch?
99. T: The switch, it doesn't matter whether you take out the switch or not.
100. Eum.
101. (1.0)
102. Think about that!
103. S1: Let's make it shorter.
104. T: Shorter?
105. S1: Yes.
106. T: Try it, let's see.
107. (3.0)
108. T: This has just one wire taken out in the end.
109. So the position is the same, right? (.)
110. The position is not different. There's nothing changed, right?
111. (1.0)
112. S2: The bulb is lit at last. ((keeps touching his circuit))
113. (0.5)
114. S2: It didn't fit well.
115. T: Eum, You done?
116. S: Yes.
117. T: Let me see.=
118. S1: =Yes, we should have fit the bulb into it.
119. T: The bulb is lit when it is between the switch and the battery.
120. T: Now, like this, the bulb is?
The teacher asks a question in line 57, and a cohort of students answer in line 58. In line 59, the teacher repeats the students' response. It is a third turn position, but the teacher is not actually doing an evaluation, then and there. Instead, she asks a question. This is done with a repeat and question intonation. And then in line 60, she explicitly asks the question that the repeat stands for. In explicitly asking the question, the teacher is marking the repeat as a 'real' question. The student answers in 61, but the answer reveals a misunderstanding of the question, which the teacher corrects in line 62, and then...
asks the same question again in line 63. Another student answers in line 64, whose reply is working within the same sequence initiated in line 60. On grounds that the first initiation and its sequence in line 57 have not yet gone to completion, i.e., they do not yet have a reply that has been accepted by the teacher, the sequence begun in line 60 is working as a sequence embedded in the larger sequence begun in 57.

The teacher asks the question again, and in 64, S2 responds. His answer is supposed to give a formal or lesson-relevant reason about why it is a series connection. However, it does not seem that his actual answer is formally rational. Instead of articulating the reason, S2 demonstrates his response with an indexical expression, ["like this"]). The teacher makes use of the third turn as a resource to continue the ongoing activity of questioning. In line 65, the teacher repeats S2’s answer in the form of a question, instead of giving an evaluation of it, and in line 66, the evaluation is done as a demonstration. There, the teacher turns the switch and something unexpected happens: the bulb does not light up, and S2 expresses surprise about it. The teacher then formulates a statement about the circuits in line 68. By doing so, the teacher shows she is still inviting the students’ response. Note that the question of line 60 is still alive, as is the question in line 57. Thus, a chance for a second response is available to the students, and S1 takes it.

68. T: You have the same circuits here, this kind of connection [...
69. S1: [The wire] is connected in a line.
70. T: How about the opinion that the wires are connected in a line?
71. How about others?
72. Jun!
73. S2: Yes?
74. T: He says it is a series because the wires are connected in a line.
75. S2: Yes.
76. T: What do you think?
77. (0.5)
78. S2: That’s good.
79. T: That’s good? Hahaa.
80. S4: Hehh.

In line 69, S1 answers again. This is the third reply from the cohort. And rather than offering an evaluation, the teacher turns that task over to the cohort of the group of students, where she nominates Jun. It is also interesting that Jun is S2, whose first answer in line 64 was being assessed by S1. In other words, Jun is now being asked to assess the answer that was working as an assessment of his own.

Earlier in the sequence, in line 67, he showed a circuit whose bulb did not light, and still has it in his hand. Apparently, Jun was not paying attention to the teacher’s question in lines 74 through 76, which are taken up with clarifying for Jun what the question is. Jun treats the teacher’s initial address in line 72 as an address, by responding with ["Yes?"] Similarly in line 75, S2 responds to the teacher’s prior turn, ["Yes "] . By doing so, Jun treats the teacher’s prior turn as though it were something simply to acknowledge, rather than a request for his assessment. Then, in line 76, the teacher explicitly asks for an evaluation / assessment of the reply in line 69. In some sense, we could say that Jun has forced the teacher to explicitly ask the question, by failing to hear the indirection in the teacher’s prior turns.

Jun is expected to demonstrate his assessment of S1’s response. After a pause, Jun responds to the question, ["that’s good"] rather than a critical assessment in lesson relevant terms. The humor here is that Jun offers a ‘vernacular’ assessment, rather than a ‘serious’ one. Presumably, that’s why the teacher and others laugh. Here we could say that the teacher’s attempt to produce ‘higher order’ thinking failed, or even that Jun actively resisted it, in refusing to hear the illocutionary force of the teacher’s address.

81. T: How about Soyoung?
82. (OJ)
83. S3: The wires connect one by one.
84. T: It means the wires connect one by one?
85. If so, why don’t you pull this off?
86. Why don't you pull off this wire?
87. Let's see if it'll make it light up.
88. What happens?
89. (0.5) (...)
90. You connect the bulb with wire,
91. Now, that consists of one wire.
92. Let's change the position in order to tell easily,
93. (1.0)
94. in order to tell at a glance that the bulb is connected in a line.
95. Just one, Hyoung's, let this one alone, just one.
96. S1: Shall we put on the switch? ((Very faintly))
97. T: Eum?
98. S1: We take out the switch?
99. T: The switch, it doesn't matter whether you take out the switch or not.
100. Eum.
101. (1.0)
102. Think about that!
103. S1: Let's make it shorter.
104. T: Shorter?
105. S1: Yes.
106. T: Try it, let's see.
107. (3.0)
108. T: This has just one wire taken out in the end.
109. So the position is the same, right? (.)
110. The position is not different. There's nothing changed, right?
111. (1.0)
112. S2: The bulb is lit at last. ((keeps touching his circuit))
113. (0.5)
114. S2: It didn't fit well.
115. T: Eum, You done?
116. S: Yes.
117. T: Let me see.—
118. S1: Yes, we should have fit the bulb into it.
119. T: The bulb is lit when it is between the switch and the battery.
120. T: Now, like this, the bulb is?
121. How about in a line? The bulb is lit.
122. We can name all these as?
123. S: A series.
124. T: =We call it a series.
125. We can see this in our textbook.
126. (0.5)
127. See page forty in your textbook. (.)

The question of line 74/76 is still alive, and the teacher presents the question again to another student, nominating her. In line 83, S3 responds, and the teacher repeats the answer in a question form, instead of giving an evaluation of it. Then, its evaluation is again done as a demonstration, across lines 85-95. There, the teacher asks the students to manipulate the circuit and demonstrate what happens. In line 96, S1 asks if they should “put on the switch” in a very low tone, and the teacher is not able to hear it. Thus, S1 repeats his question in line 98. This is S1’s self-initiated response to the teacher’s demonstration. He is trying to respond by showing his idea in the demonstration rather than by offering an explanation.

In line 99, the teacher discounts his suggestion, but then uses it to further the demonstration, in line 102 ["Think about that"]). Then, a similar sequence occurs again. In line 103, S1 makes a second suggestion, and then the teacher asks him to do the demonstration. In line 107, the teacher observes what S1 does with the circuit. After watching the scene, in lines 108-110 the teacher continues her description of the demonstration. In lines 112-118 the students are working with the circuit which did not light, in parallel to the question sequence we have observed; in line 115, the teacher asks if they are ‘done.’

After watching the demonstration together with the students, the teacher produces her
comments about the demonstration in line 119. She directly describes the circuit literally
and notes when it is lit. In line 120, she invites the collaborative completion of her turn,
but does not receive it. She then returns to her question, which has been alive across the
sequence. And then, she asks a question in line 122, which is not a why-question. By
doing so, the teacher gets the students to observe the circuit and speak about it in terms
appropriate to the lesson. The students respond to her questions, and the teacher latches
to their answer, and affirms it. Instead of providing a sophisticated explanation of why it
is connected in a series, she resolves her question by relying on a demonstration of the
circuit along with vernacular talk, [e.g., “like this,” “how about in a line?” “The bulb is
lit”]. And the question that she then asks, the question which brings closure to the
sequence, is one which awaits a recitation by the students.

To get students to correctly identify phenomena in appropriate language is a primary
concern for science teachers in implementing their lessons. In this scene, the teacher
repeats why-questions and asks other students to produce an assessment of a student’s
answer, instead of offering an evaluation of it. Yet, as we consider the sequence, it is
difficult to see here how why-questions could elicit higher order thinking from the
students. They might, or they might not. As Eisner observed, there seems to be no clue
by which to distinguish it.

Nonetheless, we can observe a few evidential features from the scene wherein the
teacher and the students actually exchange questions and answers on the lesson in this
situation. First, how why-questions could be necessarily linked to the production of
higher order responses remains vague. We even find failures in some sense. This is so
when we witness that S2 tries to resist responding to the question, and the teacher
resolves the question by relying on a demonstration along with her vernacular talk.
Moreover, if they could produce the articulation of generalization or inferential work
through why-question exercise, it would still be an accomplishment of the routine
organization of the IRE sequence. Second, when we imagine a sequence of open-ended
questions leading to a what-question, leading to a why-question format for higher order
thinking, it could take place or it could not. However, when we examine this actual
sequence across the questions, we find a different picture of the flow of the scene. That is, the basic order of IRE classroom questioning remains throughout the flow of the whole sequence.

The following scene shows similar features. The following observation was conducted in J school, which is located in a local city. It belongs to the national university of education in that area. It has better facilities and personnel than public schools. In the classroom, I found that separate places for observers had been prepared. The observers are usually in-service teachers or faculty members from the university. Thus, having strangers in the room is not unfamiliar to the classroom members. The following scene is from a lesson about the relation between altitude of the sun and the amount of light energy received on the ground and the relationship between length of shadow and the amount of light energy.

They are about to perform the demonstration in order to learn about the relationship of these two. There are materials for the lesson on group tables -- a flashlight, plumb, yardstick, and graph paper. In order to investigate the amount of light energy according to height of the light, they are to measure the width on the graph paper illuminated by the flashlight at different heights. The students are discussing the demonstration which they will conduct after the teacher’s explanation of the procedure of the demonstration. Here, the teacher and the students are discussing about the device for measuring altitude which they built in last class. The device is a plumb tied with thread to a protractor, with which they are about to measure a declination of the sun. The teacher asks them a question about the use of the equipment of the plumb. In the measuring device, the plumb is devised to fix the position on the protractor according to the sun.

1. T: Then, what's the role of the plumb?
2. Why do you make the plumb like that?
3. (
4. Why do you make the plumb like that?
5. (0.5)
6. Sang: If we weight (...) 
7. T: You mean we need the plumb so that it will be moving if we weight it. How about this? Eunok, what's something like the needle? 
8. Eun: The sun (...) (.) 
9. T: Miwha! What's that for? What's that? 
10. M: The sun (...) 
11. T: Right. 
12. We need a base point, 
13. We use a needle like that in order to set a base point. 
14. (.) 
15. The higher the altitude of the sun gets, 
16. the length of the shadow will be?=
17. S: =shorter= 
18. T: =Instead, what?= 
19. S: =The shadow is... 
20. T: // the temperature will be?= 
22. T: =rising. 

Taking a look at the measuring devise, the teacher begins to ask the cohort a question about the use of the plumb. His question takes a form of why-question here. And then, he designates one student, Sangjin among the students who raise their hand. Sangjin answers the question in line 6, and the teacher takes the answer, reformulates it, and then poses a question about Sangjin's thought instead of offering an evaluation of the answer. And then the teacher reformulates the question, referring to the plumb as the "needle." Eunok is designated by him, and she produces her answer. But it seems to be ignored. Instead, after short pause, the teacher designates another student, yet the answers are the same. The teacher seems to ignore it. The teacher repeats the question and receives the answer from Miwha, and accepts it.
Here, in beginning the segment with why-questions, it looks that the teacher is discursively eliciting an inferential answer about the measuring device from students. But as it develops, we can witness such familiar, ordinary actions as the teacher’s designation of next speaker, the order of recitation, and third turn assessments, in a procedure in which the participants collaboratively produce an accepted response. In lines 17-24, the exchange of question and answer is enacted not so much as a matter of higher order thinking, but as a matter of recognizably projectable completion. This is no less than the routine form of question-answer recitation. The questioning exercise, in the name of inferential questions, is enacted as a practical concern at hand. Here, the teacher implements the questioning exercise in order to get the students to know the role of the plumb in the measuring device. That is, utilizing the form of why-question, the teacher gets the students to enact what they will be doing with the equipment as a practical matter.

While the teacher pursues why-questions, the sequential organization of the course, as a basic order of the classroom, is still alive. The question-answer practices proceed as a practical matter of the enactment of the lesson within local, interactional turn-by-turn organization rather than higher-order reasoning. What is required for the teacher and students alike to build a lesson in the sequence of question and answer is practical actions and a practical sense of what they have done through which they immediately deal with contingencies in the course of actions, e.g., a sense of what should be taken as appropriate actions, or what should be set aside. That they are doing so is a practical matter in the context. By doing so, they find the adequacies of question and answer within the flow of actions.

Even if these ‘higher order’ questions were designed to be an alternative sequence to IRE, they still display an orientation to the basic order of classroom questioning. In other words, ‘higher order questions’ are still assembled turn by turn, and show the achievements and contingencies of ‘common understanding’ across turns. Higher order questions are no less interactionally produced, which is observable in the transcribed sequences. They function in this way, in the context of cohort-based instruction, when
teachers are teaching students who do not know their curriculum. That is the task that every program of instructional innovation will have to confront. It may also have a great deal to do with the persistence of reform efforts, and the durability of questions with known answers.

4. Discussion

This study has found that questioning and answering for the teachers and the students alike are as much a matter of the social organization wherein the teachers enact the lessons as a matter of a test of knowledge. They are so because questions with known answers are enacted within setting-specified activities as they unfold in real time and space. In the cases of the teachers described above, even while they try to invite, command, lure, await, and urge students to raise questions and to make the students see the problem in the given field, in order for the students to resolve them, those actions routinely unfold in the form of questions with known answers. The teachers' questioning exercise seems to be a practical skill which is needed, for the teachers, as the most accessible method for the purpose at hand, e.g., to invite and provide students with an opportunity for access to what they will treat as the day's learning topic. The cycle of question and answer reveals demonstrably and continuously an orientation of students - teachers to the sequential order and production of their discourse.

Even though classroom questioning is such a familiar conventional practice in classroom lessons, there have been recurrent efforts to transform it. Nonetheless, concerning why the use of questions with known answers is such a compelling way of enacting classroom lessons, this study finds good organizational, and practical reasons for doing so. First, those practices are constructed for cohort-based lessons. Most of all, the relevance of questioning and answering is constructed along with the sequential achievement of the two party-organization of the room. The two-party organization, wherein the teacher speaks and the students listen, is a familiar scene in the normal
organization of classroom interaction and lessons (see McHoul, 1978; Mehan, 1979; Payne & Hustler, 1980 on the organization of classroom speaking structure).

The setting of the classroom is reflexive to the sequential organization of the two-party structure, in that the latter is the ongoing achievement that renders the setting sensible as a common world. The participants accomplish the social relationships between participants through their commonsense knowledge of the organization of the setting. They do what they do with tacitly accepted and taken-for-granted assumptions of the setting and their practical competence to its organization. By doing so, they are "doing being ordinary" (Sacks, 1992) in their social identities of teacher and student.

Questioning and answering is one of the most distinctive practices in the construction of the social organization of the classroom.

For the teachers, questioning and answering is also a strategy to resolve the practical problem of management of the student cohort without time-out in enacting the lessons. For instance, owing to the time constraints of classroom lessons, it seems that there is no way for teachers to simply wait for their students to initiate their own questioning. In addition, it is not plausible for the teacher to ask students to check their own questions and answers individually. The answer is already known to the teacher and possibly a part of the cohort, and the teacher and the students acknowledge such a fact. Then, the practical problem for the participants is when to reveal it, how to reveal it (Macbeth, 2000). By their strategy in doing so, the teachers can find out what the cohorts need to know and what they already know. In this way, the local order of the classroom in the questioning exercise and how it is constituted is not separate from what the teachers teach and what the cohorts learn. In actual lesson time, the one never takes place without the other.

Second, notwithstanding the fact that the answer is already known in the setting, the enactment of IRE sequences is interactionally constructed turn-by-turn, which then serves to enact the lesson assessment of questions with known answers. This shows a somewhat different view from critical discourse. The critical approaches to school pedagogy have raised complaints that a teacher-dominated interrogative style of instruction might bring
about an imbalance of speaking rights or of power relationship, in which only teacher-bound evaluation of the adequacy of the answer might be pursued, and has explored possibilities for a more democratic way of enacting instruction. However, closely viewed, the IRE sequence is a collaborative achievement in contextual, practical "knowledge-based" action within the setting. This is so because the known answer routinely works not so much as an end-point of the ongoing lessons but as a resource to enact the next phase of the lesson. As seen in the observed scenes, the fact that the answer is known is not a privilege for teachers, because the immediate issue for him/her is how to guide the students to see the lesson in the way the answer is meant to demonstrate.

Third, while reform discourses plan to devise a higher-order questioning exercise as an alternative mode of classroom questioning, the basic order of the IRE is still persistent within such a sequence. Regardless of whether or not students' higher order response might be successfully achieved with such exercises, those practices are constructed within the turn-by-turn local order of the IRE. When we scrutinize the actual sequences of the IRE, we find they are practical, immediate. Thus, even when teachers are struggling with eliciting a generalization or inferential reasoning from the students, the fact that we still find this effort embedded in the basic local order of the lesson reminds us of what is so familiar and stable about classroom questioning. These three facets show what the routine grounds as a durable condition of classroom lessons are like, and any reform efforts, whatever they are, should take them into consideration.

The cases also remind us that questions with known answers are "grammars of schooling" (Tyack & Tobin, 1994) that are "socially constructed" in classroom lesson time. That they are so is parallel to certain feature of the authentic pedagogy discourse, particularly that affiliated with social constructivism. In the routine organization of questions and answers, we might also find the familiar attributes of authentic learning: e.g., immediacy, actions interwoven between self and the world, indexicality, negotiated meaning, situatedness, collective action, the primacy of context as a resource for ongoing activity, etc. These features irremediably constitute the social organization of the
mundane classroom lesson in which curricular activities are shaped.

The sequential organization of question and answer provides the participants with local circumstances that order the next course of action. Teachers' questioning provides local environments with courses of action to follow, within which students can momentarily find the relevance of what follows, regardless of whether it is action or utterance. The order of their lessons depends upon the discursively managed feature of questions and answers. The sequential environment unfolds along with practical relevancy in the process of question and answer. Participants in the process are perceiving what to do next in the immediate occasions in the classroom. How this is accomplished is not so much an exercise in a formal knowledge domain as a practical matter for the teacher and students alike.

In this way, the cycle of question and answer in the classroom lesson resembles features of problem solving in ordinary settings. This is so not in the sense of formal procedures or heuristic models, but in the sense of sequential order within a practical environment. In authentic learning models, problem-solving is comprehended as a concrete and context-bounded process, which unfolds in action in everyday settings, rather than as a formal problem or answer, measured to formal criteria. Especially, learning in authentic practice includes being able to see contingencies in context as problem and solution for the ongoing next activity. This is not the same as what is assumed in many heuristic teaching models, in which problem and solution are unfolded in knowledge domains. When reform discourses treat classroom questioning as an

---

26 About a decontextual approach to problem-solving, Lave (1988) argues:

There is little in this [decontextual] genre of research to hold its analyses to events in space and time, partly because, in the functionalist conception, knowledge is necessarily abstracted from experience. This belief is reflected in the common concept of "knowledge domains," a term that appears to locate knowledge-in-use in time and space without in fact doing so. Here, too, ambiguity may be the advantage which gives the concept a secure place in discussions of cognition; it provides a pseudo-space, an illusion that knowledge is the
impoverished version of authentic problem solving outside of the classroom, they miss those features that organize each setting, and what is common to them.

Researchers on classroom interaction assume the sequential order of question and answer, which establishes symmetry within three-part and extended interactional sequences, as essential to the basic organizational structure of classroom lessons (see Mehan, 1979). Its durability in the setting of classroom lessons comes from the seemingly unavoidable necessity of its use, which implies that anybody who goes into the room cannot help interacting in this way repeatedly. Questioning is the very feature which renders pedagogical the mundane classroom setting, in particular, where early grade students are involved. Thus far, the question of how not to be engaged in such a sequence in classroom lessons remains beyond our understanding of everyday classroom practice, in classrooms constituted as we know them.

context of problem solving. But the effect on cognitive research of "locating" problems in "knowledge domains" has been to separate the study of problem solving from analysis of the situations in which it occurs. (p. 42)
CHAPTER 5

INSTRUCTING AND ENACTING DEMONSTRATIONS

1. Demonstrations in science lessons

Demonstrations are a commonly observable classroom practice in conducting science lessons. Demonstrations are exercises in which students should link their observations with what they know of their science lessons. One of the crucial concerns for teachers in demonstrations is how to manage the field in the setting in order to guide students as they follow their demonstrations. A manual used as a teaching guide points out that teachers should be cautious about the fact that when they provide for the students a situation approximate to “real” science, it could elicit a high degree of anxiety or confusion from them. That is, science teachers need to be concerned with how they organize demonstrations in order for the cohort of students in the room to see and say what the teacher wants to show as a lesson, and thus to follow the demonstration along with the observation of it.

Atkinson and Delamont (1977) call the exercise of demonstration “stage-management.” They have studied a comparative description of clinical medical instruction and school science, and examined how discovery instruction is achieved through the practical work of “stage management.” In order to explain the nature of medical and science teaching as practical work, they introduce the distinction between
In medical practice, there is a distinction between 'hot' science and 'cold' science, and hot and cold medicine, in which the former refers to the pedagogy of actual practice, and the latter to the management of a “mock-up.”

Reporting a medical student’s observation of his bedside instruction, they point out that the procedure of bedside instruction in the medical institution is designed and conducted as if the diagnosis of the patient’s condition were starting afresh rather than already known by the doctors. In order to do so, when medical students are involved in bedside instruction, instructors set aside what is already known about the patient’s illness. By doing so, medical students in bedside teaching are given practical opportunities to take histories, perform examinations and formulate diagnoses, as if they were under the normal circumstances of hot medicine. The instruction proceeds as a simulation of hot medicine because it is designed for (re)construction of selected features of the ‘real’ situation, in order for novice doctors to experience the practice of medicine without the danger of being actually exposed to circumstances wherein emergencies could occur.

Through a close examination of the simulated features in bedside teaching, Atkinson and Delamont describe how discovery instruction in school science shares some important features with bedside teaching. They formulate this description of discovery instruction:

[S]chool science proceeds on the tacit assumption that the pupils are engaged in the ‘discovery’ of phenomena which are already well-known, and which the teacher has already set up as the end point of their endeavors. In other words, what is at stake in teaching situations of this sort is not so much that the relevant conclusions should remain undisclosed, but rather, that they should appear in the appropriate manner and at the appropriate time. (p. 103)

Atkinson and Delamont note that such a replication entails the “stage managed” revelation of knowledge by the instructor. They report that the work of stage management of science lessons requires practical skills for immediately dealing with contingencies for all practical matters. They also point out that such practical skills are
required of students as well as teachers. That is, the teacher and students should act as if the answer to what they are inquiring into were not already established. They observed that some of the students threatened the management of the lesson when they tried to treat the encountered situation as 'hot' science, or, on the contrary, tried to affirm the nature of the 'cold' science of the classroom demonstration situation. The management involved in sustaining the demonstration's reality depends upon the participants' acting as if the answer to the puzzle were not already established or as if the phenomena under consideration were not to be treated as too problematic. In this view, the achievement of the guided discovery is the outcome of the collaboration of both teacher and students in that the process must be respected by all parties in their interaction in order to be successfully sustained.

Atkinson and Delamont showed how teaching practices proceed in socially organized ways, in which the participants produce a kind of 'working model' of medical diagnosis or scientific experimentation in such a way as to make observable, teachable and reproducible the methods whereby these things are normally done by competent members of the respective professions. In as much as students in the science classroom do not have access to 'hot' science, as the medical students are not directly involved in "hot" medicine," the students experience the science curriculum in such a way to replicate features of 'real science.' The authors characterized such replication as "mock-ups." Following Garfinkel and Sacks (1970), they note:

Mock-Ups. It is possible to buy a plastic engine that will tell something about how auto engines work. The plastic engine preserves certain properties of the auto engine. For example, it will show how the pistons move with respect to the crank shaft; how they are timed to a firing sequence, and so on....

Let us call that plastic engine an account of an observable state of affairs. We offer the following observations of that account's features. First, in the very way that it provides for an accurate representation of features in the actual situation, and in the very way it provides for an accurate representation of some relationships and some features in the observable
situations, it also makes specifically and deliberately false provision of some of the essential features of that situation. (p. 263)

Demonstrations seem to work this way, and the interactional view of the social organization of teachers’ demonstrations in science classrooms has illustrated how it works as a distinctive curriculum for teacher and students alike (Also see Lynch & Macbeth, 1998; Macbeth, 1996, 2000). The point is that the very nature of the social organization where the demonstration is conducted deeply shapes the events that elementary-level students can see, engage in and be held accountable for. This approach closely describes how the teacher's discursive exercise is coordinated with the material array in the demonstration of science lessons, and how the process poses a curricular task for the students “to find the objects of the demonstration - ‘what happened’- from within the order of activity they have found” (Macbeth, 2000, p. 49). The approach shows how teachers’ vernacular discursive practices pervade the field of the demonstration, along with practical actions with which teachers make use of the already known information about the related lesson.

On the other hand, the mock up-like feature of demonstration activities in science lessons is also a target of critique, in that it might limit the possibility of allowing students to establish a relationship with what they are inquiring about in an inductive way (see Tobin, 1993 for critiques). Most progressive educators and researchers have claimed the superiority of “self-motivated” activity methods, in which students find ways to learn appropriate skills and knowledge in a way more meaningful for themselves. Most of all, one concern here is about how to teach procedural knowledge and practical skills. In many cases in which instructional reform is recommended, various modes of classroom practice have been proposed to substitute the teacher-centered direct instruction. There is a coherent assumption, driving from a pedagogical principle, that practical experience and activity are essential in acquiring the skills and knowledge involved, which has been familiar in educational studies for over a century: e.g., Deweyan ethos of “learning by doing,” teaching reflective practices (Schon, 1983), knowing-in-action (Munby &

160
Such an idea as 'learning by doing' has been shaped by variously affiliated theoretical branches of educational studies, and, more recently, rising interest in the discourse on ‘situated learning’ has provided a more systematic ground for the rationale of the reform claims (Brown et al., 1989; Jonassen & Land, 2000). This trend is also distinctive when we take a look at the area of science education. In particular, as the idea of social constructivism in studies of science education has been popularized, reform agendas in science education have embraced similar discourses and models (see Tobin, 1993). Many researchers and educators in the science education area have reported that the organizational constraints of school culture obstruct the implementation of authentic science education (e.g. Jimenez-Aleixandre et al., 2000; Munby et al., 2000; Vesilind & Jones, 1996), and their critique of the school constraints has supported reform discourses.

Reform discourses have called for changes such as constructivist teaching, hands-on science, the teaching of process skills to allow students to engage in the social and discursive processes involved in making sense of experimental proof. These discourses are concerned with how to create more concrete, material inquiry environments as a condition for authentic learning activities where students experience inquiry to learn to see and speak with appropriate scientific concepts. They have suggested that students might learn by doing real inquiry like scientists who are actively engaged in the work in their labs, wherein students depend upon their own power to control the course of inquiry.

In particular, social constructivist discussions often propose that such a teaching method serves the role of a medium to help students to develop better understanding of science through use of authentic tools including scientific discourses, scientific tools, scientific networks, and so on. We can hardly suggest that those claims are unfamiliar. The idea of authentic science lessons based upon open-inquiry methods, which assumes a procedure from actions to achievement or a goal of collective cognition, e.g., “problem solving procedures that is to means / ends relations” (Lave, 1988, p. 127), persists, regardless of what its claims and theoretical assumptions would be. As a matter of fact, the various endeavors to explicate how to enact such a lesson style represent an enduring
common belief among researchers and educators about the better teaching of science, and it has been an essential part of the repertoire advocated for a strong policy of reform.

Nonetheless, if the routine character of a demonstration invariably appears across the settings, reform proposals should encounter the problematic issue of to what extent they can re-shape the classroom practices in pursuit of authentic inquiry-based lessons. This study poses such a problem, particularly by relying on discussions of the nature of demonstrations of scientific experiment as a practical matter in social studies of science. Those discussions have treated the issue by means of close description of historical or local cases and have explicated how a demonstration as a public event is socially constructed as a practical matter of building the local order in the setting. In order to understand the context of demonstration in science lessons, it will be helpful to consider the nature of a scientific experiment and that of a demonstration, because through such consideration we can examine the reform discourses that have searched for an authentic model for science lessons associated with the shape of actual professional work.

2. Demonstration, experimentation, and display of virtuosity

Social studies of science have provided detailed and vivid cases for describing ordinary practices and vernacular discourses wherein science lab work is achieved, thus enriching our understanding of the complex fields of activity called science. This approach provides implications about how the social context and the members' procedural sense of it are closely tied to the order and the meaning of the event. Regarding the nature of demonstrations in the scientific enterprise, Collins (1988) gives an explication as to how demonstrations of experiments could be different from experiments themselves.

According to him, the former indicates an enactment in a public space and the latter implies a private space. In the case of the scientific enterprise, an 'experiment' is done to find out something about 'the natural world,' whereas a 'demonstration' is intended to
reveal what has been found out to an audience. The demonstration of an experiment is
designed for direct witnessing by an audience which is more or less unfamiliar with the
work of the experiment. Here, demonstration of the experiment is concerned with
whether the experiment will be reproduced, rather than what the experiment will produce.

For instance, regarding how the concern for demonstration of an experiment is a
practical matter of reproduction of the experiment, Boyle’s air-pump experiments in the
seventeenth century provide an exemplary case. Shapin and Schaffer (1985) have
explicated the relationship between an event categorized as natural and the context of the
public space where it is embedded, by closely examining the case of Boyle’s experiment
of pneumatic findings in the 1660s. According to them, for Boyle in those days, the
problem of how to get legitimacy of his new experiment was how to multiply the
witnessing experience of it; as they called it, “the creation of a scientific public.”

In other words, it was a matter of how he could repeat the “original” observation of
the new experiment in front of audiences who were not familiar with it. The problem was
as much social as natural. It had to do with how to facilitate access to artifacts, to whom,
where, as well as epistemological questions, i.e., how to know, since, if that witnessing
could be extended to others, then his work could be constituted as a matter of fact. First
of all, the experiment had to be performed in front of gentlemen whose reports could be
trusted because of their position in society. The success of the demonstration of the
experiment relied on the credibility of the witnesses, because it included their moral
constitution as well as their intellectual competence. Shapin and Schaffer note that
“[T]he credibility of witnesses followed the taken-for-granted conventions of that setting
for assessing individuals’ reliability and trustworthiness” (p. 489).

The problem was how to build an experimental situation similar to the original which
could be directly observable by anybody. This was a practical matter of building a fact-
making machinery. For this, Boyle had to construct what Shapin (1984) calls a
“technology of virtual witnessing” (p. 491) which included a set of material, textual, and
organizational practices that reflected the circumstantial aspects of the laboratory and air
pump apparatus. It had to be a device that could reproduce the original scene of the
experiment any time, any place and for anyone. In order to guarantee the reproduction of the experiment, technical expertise was required to manage contingencies and materials. For instance, the aim of the experiment was to achieve a working vacuum, for which great technical care was required so that the pump would be sealed against leakage it routinely leaked. Furthermore, the density of circumstantial detail, which could endanger the replicable work of the machinery, drove him to select some features of possible contingencies to report in advance of the demonstration of the experiment. These were all delicately arranged in order to make sure that what was expected to take place would be seen.

As observed in the discussions above, even in many cases of science work competent scientists are engaged in demonstrations as a practical matter. Furthermore, the cases of science lessons in early grade levels are quite different from demonstration of experimentation. For while the demonstration of an experiment is required to legitimate the outcome of it, school science is not designed to implement "a demonstration of a newly discovered effect." Rather, it has to do with "a celebration of past successes" and how to teach those to the students (Collins, 1988, p. 729). For in school science, what is to be tested through the demonstration is not the teacher, nature, or the related science knowledge but the students themselves. In the case of the demonstration of newly discovered effects, the demonstration should be performed faithfully, because the demonstrator is concerned with the reproducibility of the result without influencing the audience. However, demonstration in science lessons proceeds as a "stage management" in which the teacher selects and orders contingencies as relevant or not and simultaneously displays the selected features in ways that are viewable, and intelligible, for the students.

The demonstration has to do with a "display of virtuosity," as Collins (1988) calls it, in which the demonstrator reveals his technical expertise to handle the phenomena. Here, what is meant by virtuosity is a technical ability with which one can relieve the demonstration from the contingency of experiments, while claiming to place naive witnesses in the presence of science. It is a competence to find and manage the
phenomena at hand as relevant or irrelevant to the already-known knowledge to be illustrated in the outcome of the display, rather than that of how to wait and see how nature reveals itself. In this case, virtuosity is revealed in teachers' competence in instruction through demonstrations which is concerned with how to display demonstrations in order for students to recognize relevance and irrelevance in the contingencies in the course of the demonstration. And, for the students, virtuosity should be mastered in the procedure of demonstrations, in that enacting demonstrations is a matter of finding contingencies relevant or irrelevant, which would display their competence.

In sum, the occasioned features of instructing and enacting demonstrations in science classrooms would be as follows. First, most experimental activities in the science classroom can be considered demonstrations in that they are not planned to find a newly invented outcome but to display already-presented knowledge. Second, a demonstration is enacted as a practical matter of how demonstrators are dealing with contingencies for the purpose at hand. The fact that the teacher and some of the students already know the outcome does not tell us that they do not have to do the work of finding this relevancy. Third, it is only within the practical procedure of the enactment without time-out that teacher and students find this relevancy. These features render demonstrations in science classrooms familiar and common. If these features are durable, we wonder to what extent reform plans such as open-inquiry based lessons along with social interventions by means of authentic tools could replace them.

Understanding scientific work brings into view how demonstrations in the science classroom are enacted not just as a matter of display of an experiment but as a matter of how to enact a demonstration and how to teach it. This gives us a basis with which, by closely examining actual occasions in early grade-level science lessons, we could reconsider reform proposals that find an ideal teaching model in authentic inquiry-based lessons. It opens the possibility that our images of reform could be a product of our idealization of a disciplinary culture which is difficult to find even in the actual professional world of the scientific enterprise. And if the routinely observable order of
practical actions in science classrooms also turns out to exemplify certain features of the professional work of science, we wonder to what extent teachers, with plans to pursue teaching methods of authentic inquiry-based lessons, could transform those routine practices, particularly in the early grade science classrooms.

To conduct such examinations of classroom science demonstrations, this study relies on a praxiological approach as an analytic perspective. This approach has been taken in ethnomethodological studies, and brings into view how ordinary actions and vernacular talk serve as constituent parts which sustain those activities (see Coulter, 1989; Lynch, 1993). The praxiological view will show us how demonstrations in science lessons are performed, including those features that reform proposals for open inquiry-based lessons have suggested.

3. Instructing demonstrations

[Setting I]

The following scenes come from the observation of the 5th grade science classroom in B school give us a brief description of B school. The lesson was implemented in the science lab of the school. The demonstration was designed to teach the students about the nature of acid, neutral, and base solutions. The purpose of the lesson was teach the students how to identify an acid and a base in materials that we use daily. The demonstration was prepared as an instruction for later student activities of performing it themselves. The teacher demonstrated to the students the procedure of how a neutral fluid is acquired from the solution of a base and an acid, including how to use the tit pipette, the test tube and the glass beaker, and how to identify the fluid and its change.

The teacher arranges phenolphthalein, sodium hydroxide and hydrochloric acid along with equipment for this demonstration on the desk. The teacher distributes the materials and the equipment to students groups, and explains about the related procedure for using the equipment and the cautions students should follow. After setting up the materials on
the table, the teacher goes on to start the demonstration in order to show how they set-up
the materials, and how the students will make an acid, or base solution. The following
scene is taken from the teacher's instruction of the demonstration.

At the beginning of the procedure, the teacher picks up a test tube containing the base
fluid of sodium hydroxide, and with the tit pipette takes a drop from one of the glass
beakers containing phenolphthalein fluid. Phenolphthalein fluid is prepared to detect the
nature of a material regarding whether it contains an acid or base. With the addition of a
drop of phenolphthalein fluid, the students see a change in the color of a base fluid from
transparent to red. Next, the teacher demonstrates how to transform the base fluid, by
making a solution with the acid fluid. They then watch the process in making the
solution.

1.T: Now, (0.5) Let's see what this is.
2.S: Sodium hydroxide.
3.T: Sodium hydroxide? Really?
4.S: Yes.
5. (...)
6. (Pinkle, Pinkle) (shouting))
7. Woo.
8.T: It is really sodium hydroxide.
9.(S): It's dilute sodium hydroxide.
10. (0.5)
11.(S): (...)
12.T: See, the experiment we do is to make dilute (.)
13. S: ((Chatter is getting lower))
14.T: Dilute sodium hydroxide (.)
15. S: ((Chatter stops.))
16.T: Dilute sodium hydroxide mixed with a drop of the phenolphthalein fluid.
17.S: Yes.
18.T: And then, in order to make it a neutral fluid,
19. which fluid do we need to put in?
21. T: Acid fluid.
22. What did we choose as acid fluid?
24. Dilute hydrochloric acid.
25. T: We take hydrochloric acid.

The sequence of this scene shows how beginning the demonstration is enacted as a practical matter. For the students, the prepared fluids of acid and base are not easy to tell from each other. So, getting them to identify which fluid is going to be used in what sequence is necessary in starting the demonstration of making a solution. He is doing so in order to make the procedure for using the fluids followable by the students, particularly here in the exchange of questions and answers.

In line 1, the teacher is holding the tit pipette in his hand and prepares to identify the fluid in the test tube with a drop of phenolphthalein fluid from the pipette. He does so along with a formulation of what he is going to demonstrate [“Let’s see what this is”], which then invites the students’ response to it in line 2. In the line 3, the teacher repeats the students’ response in the form of a question. Along with the exchanges of question and answer, the teacher performs the demonstration as if it were a test of what they have answered. More exactly, in doing so, such exchanges give the students a practical sense of the procedure. The teacher and the students then watch the scene while the drop spreads into the fluid in the tube. Some of the students applaud and speak out about what they are seeing in the change of the color state of the fluid in the tube. They identify the color pink with the name of an animated character, “pinkel, pinkel,” [which is the name of a Korean popular teenage star group]. After the drop falls into the beaker, and watching the state of the fluid, he affirms the students’ response in line 8.

In line 9, a student initiates a response to correct the teacher’s identification of the material, that it is “dilute sodium hydroxide.” By doing so, the student is specifying what
the teacher has shown. The specified answer is then picked up by the teacher in line 12, in his continuing formulation of the task and procedure, in lines 12-16. And then in line 17, a student shows an affirmation of the teacher’s discursive demonstration. Then, the teacher goes on to the next phase of the demonstration, across lines 18-21 and 22-25, where the teacher and the students produce consecutive IRE sequences. These sequences are embedded in the enactment of the demonstration in which the teacher picks up the test tube of acid fluid and then takes a drop of it with the tit pipette. In doing so, the teacher keeps pulling into view the procedure of how to make the solution of a neutral fluid from a dilute base fluid in order for the students to follow it.

Whatever steps the procedure produces, they are still embedded in the order of the course of practical actions: the procedure of how to identify the materials in the test tubes, how to make the mixture and the solution, and how to observe the change of the color of the fluids. Also, the teacher makes use of the social, practical organization of the IRE sequences and thus discursively prepares the field of the demonstration, along with showing with his hands how to use the equipment. Through such practical actions, he shows the students the activities which are called for in their instruction.

With this, the teacher produces a thoroughly practical demonstration for his students. That is, he directly shows the students “how to do” the demonstration. There is a mundane character revealed in instructing demonstrations, particularly in starting them, and we could ask if it might be possible to teach such a procedure without being involved in such practical actions? If it is not possible, it raises the question of whether we could

---

In lines 12-16, the teacher’s talk is interrupted, owing to some student noise somewhere in the classroom. After pausing for a beat and staring at the place where the noise is coming from, he resumes his talk in 14. He repeats a similar process once more, and then he finishes his formulation of the task at hand. While the teacher effectively manages the classroom situation, his demonstration of the lesson continues without time-out (McHoul, 1978; Payne and Hustler, 1980). The procedure to keep the demonstration on track goes on as a constituent of the local order of the classroom.
distinguish a reformed model from a non-reformed model, when they encounter this kind of situation. For such practical procedures render demonstrations in science classrooms routine.

27. If we make too many drops, we can't tell (...).
28. (S): //It will be acid.
29. T: So, we will put acid fluid very slowly into (...)
30  (1.0).
31: It became a little bit more transparent, but still.
32. S: Still we can see some violet color a little.=
33. T: =Is there?
34. (S): No, we can't see it. (...)
35.  (0.5)
36. T: Let's see, this is not, maybe, not neutral, but I'm sure it's not
37.  base.
38. S: Yes, it's acid or neutral.=
39. T: =Right? It's neutral, or acid.=
40.  =As you guys can see, just a little drop, like this,
41.  made it quickly change, didn't it?
42. S: (Yes.)

In this scene, the teacher continues with the demonstration by dropping a drop of acid fluid into the tube of base fluid, and then watches the change of the color. While the teacher enacts the demonstration, he shows how slowly he has to introduce the acid into the tube containing base in order to produce the display. The teacher does so, jointly producing talk with the students who immediately complete the teacher's explanations about what could happen (in lines 26-29) and what happens (in lines 31-32). He does so in vernacular terms, ["too many drops," "very slowly," "a little bit more"]. With this, he shows how to enact and view the demonstration. Then, the teacher changes such
vernacular words into the scientific concepts in lines 36-37, and he gets an affirmation of this from the students in line 38. The teacher and the students immediately note the change and speak of it in scientific terms without introducing any measuring tool. Instead, the teacher and the students continue watching how the drops of acid fluid are dispersing within the test tube, and fitting their talk to what they see.

Here, there is a point which draws our attention regarding the question of what they are actually involved in -- it does not seem that they upgrade vernacular talk into scientific terms. Rather, they alternate their ways of speaking, and in line 40, the teacher provides a summary account of the procedure, in the vernacular: “line 40.” The enactment works prospectively and retrospectively, in which the teacher brings into view a practical sense of such a procedure. In this way, what they are seeing becomes a basis for re-viewing what they are doing. Even if they upgrade the mundane talk into a form of scientific discourse, the procedure of it is still embedded in the enactment of instructing the demonstration.

Somebody might say that these are merely ordinary actions, but it could be a “theory-laden observation” (Hanson, 1958) of a material array too, i.e., scientific measurement. However, it does not tell anything about what happens there and then. The work of measuring drops does not seem to be predetermined by objective criteria. Rather, by learning to compare the current color with the next state of color, they learn when they should stop the dropping and confirm that the change in color is what they have expected it to be. In this way, the temporal array of the material cannot be differentiated from the criteria. It is a certain kind of measuring, in which the measuring is read in the materials rather than from a ruler, or scale. It is a local order of measuring, in which the ‘measure’ is itself embodied in the course of action. These are ‘bodily measures,’ which are observable in instructions like “tip it like this,” “pour slowly,” “hold it like this,” etc. It is a far more ordinary one, like the kinds of things that could be observed when we are engaged in a cooking class.\(^{28}\)

\(^{28}\) Schoenfeld (1998) has demonstrated the parallel between making pasta and math problem
Note that in line 34, a student says, that he cannot see what the others can see at that time. This shows how the field must be made visible for novice eyes, and how the effectiveness of the demonstration begins with what novice eyes can see. It is as though the teacher is working to bring something into view, and in fact he does so. Making measuring visible and intelligible for the novices would be a primary concern for the teacher. He does so, displaying the embodied reading of the materials in plain terms, which works as a curricular exercise for the students.

Is it authentic scientific work? Of course, it does not share the features of scientific work in many ways. The features in this scene would be really different, but this may not be because they fail to use scientific concepts. In the example from the 17th century mentioned above, in setting up an artifact to demonstrate his experiment to the public, Boyle had to manage the immediate circumstances with his verbal explanations, whenever the machine did not work appropriately. He made use of vernacular explanations without the need for them to be mediated by exact scientific expressions. Similarly, the teacher and the students in this scene never measure, how strong or weak an acid or base it might be before it reaches the state of neutrality. Nonetheless, their observation of the measurement seems so evident in the given "local complexes of actions" (Lynch, 1993), without losing a sense of generality, acid and base.

Lynch (1991), following Sacks (1987), explicates measurement as phenomena of members’ method. According to him, competent use of measurement is more than a matter of:

[c]alibrating ‘precision’ to the requirements of the circumstances, since what is said with a numerical or non-numerical expression of, for example, time, length, quantity, solving. He notes: “I have learned to read its [the dough] properties or perceive the affordances it offers to the point where the visual cues the dough provides tell me how to adjust the quantities of the major ingredients and when the dough is ready to go through the rollers of the pasta machine in a way that requires minimal effort on my part” (p. 302).
Rather, the relation between criteria and what is measured is reflexive, meaning that they constitute each other in situ. He argues that searching for the determined correspondence between them does not tell us anything about the event under investigation. Instead, he suggests that such a question needs to shift to whether or how distinctions between ‘precise’ and ‘approximate’ measures are locally relevant in various practical activities. Just as ordinary actions form a routine of competent members in the scientific work, it is also a mundane feature in enacting demonstrations in early grade-level science classrooms. If so, we should ask to what extent the practical use of vernacular terms and immediate measurement without “authentic” scientific tools in this scene, and the virtuosity to read the change of materials in itself, could be avoidable for the teacher and the students in teaching and enacting demonstrations.

The scene continues to show similar features regarding how the teacher enacts instructions of the demonstration as a practical matter. In the following sequence, the teacher is demonstrating how he reverse the change from acid fluid to base fluid, with base drops in the pipette.

43. T: Let’s change this back to base again.
44. (1.0) This is complicated. (0.5)
45. You should be cautious about making a drop, very slowly.
46. (S): Why?
47. T: Why?
48. Because we are gonna make something close to neutral.
49. If we put a large amount into it, then what happens?
50. S: It becomes acid. = No, base.
51. T: //So, we need to put it in slowly, OK?
52. (S): Wow, pinkle pinkle!
The teacher keeps showing while talking, ["Watch here," "This is complicated," "very slowly," "We need to put it in slowly"]). By doing so, he demonstrates how to handle the drops. The field of demonstration is a space which the witnesses must become oriented. They do not find that the adequacy of the dropping by following disengaged or prescriptive criteria. Instead, the teacher maintains the stage of demonstrations whose adequacy is built in as discursive and bodily motions, while manipulating the materials, in order for the students to see the procedure.

One student immediately interrupts the course of the teacher's talk, with the question, "why?" In line 48, the teacher initiates his talk in the form of offering a response, ["because..."]). However, this does not seem to be a direct answer to the student's question. Rather, it appears that the teacher refers to what he is going to do at hand, and then, making use of what he is saying, asks the students a question, [i.e., line 49].

The student's answer, in line 50, turns their attention back to the demonstration's enactment, and becomes a resource for the teacher to repeat his instruction, line 51, which does not seem so much sophisticated as practical [i.e., "so we need to put it in slowly"]). That is not necessarily a complaint. Rather, he is teaching the procedure as a practical task. The teacher's demonstration presents a typical example of a practical instruction, the kind we might use if we were teaching students how to sew. It is an ordinary, practical matter of 'normal procedure.'

Similarly, in the following scene, the teacher's instruction of "procedural knowledge" continues. The sequence shows that after making an acid fluid in the beaker, the teacher demonstrates how the acid fluid can be transformed into a base fluid. In order to do so, the teacher gets the cohort to watch how he is making the solution of the fluid, with bodily expressions.

53.T: Let's put in a little, and then shake it and (. make it go away, (.)
54. put in a little, and then shake it and (.=)
55.(S): =Make it go away.
56.T: Make it go away:: again, (. Make it go away:: again, (.}

174
57. Make it go away: again.
58. Just keep trying it until you can see a little bit of red color.
59. (0.5)
60. We can tell, right now, this is very strong acid, right?
61. S: Yes.
62. T: This is very strong acid.
63. S: Wow, heehhhh.
64. T: See? It's still.
65. We can see what a strong acid hydrochloric acid makes it.
66. (S): Why don't you try with weak acid?
67. S: (…)
68. T: Now, you can see the color hasn't changed any more, little by
69. little.
70. (6.0) ((The teacher makes a drop))
71. S: Wow!
72. (Shake it!)

In lines 53-57, the teacher repeats the introduction of a drop of the base fluid into the
test tube, and simultaneously formulates what he is doing. And using the quick pause in
the middle of the teacher's paced utterance (line 54), the students who are witnessing the
spectacle join in the flow of the narrated action. Bodily expressions together with
material array without division between the two are brought into order so that they are
assembled into what the students can see and say about it. The students watch the
teacher's work, collaboratively completing the turn across the lines 54 and 55. Then the
teacher acknowledges this, and repeats it. Continuing to introduce drops of a base fluid
into the tube whose state has been acid, he finds that the change of color of the fluid in
the tube is slow.

Then, in line 58, he articulates what he has been doing and what he is going to do, in
plain terms like "a little bit of red color." Their witnessing along with his talk are
reflexively constituting the demonstration field. By this, he shows the students how to
see the change of the state in the beaker and the color of the solution. While doing so, he is checking on the students' understanding of what they are seeing now, i.e., very strong acid. In line 70, the teacher keeps silent for a while though he is still making drops. The students are watching the spectacle together and are shouting expressions like "wow." And some students are even speaking out to the teacher telling him to shake the tube for a better solution.

The pace in which the drops are spreading in the tube is coordinated with the teacher's talk, and together they construct the field of the demonstration which simultaneously gives order to what the students can see and hear. He makes his actions of dropping accountable to the students, which is reflexive to the flow of the setting. The color is immediately brought into view, being paced with the following actions and commentaries. The condition of the material is used as criteria in situ, and simultaneously the condition of the material is identified with the criteria. Such a pragmatic use is achieved in and by the assembled features of talk and action. In this way, the demonstration is made comprehensible to the participants in the situation.

As Taylor (1993) notes, "every apt, coordinated gesture has a certain flow" (p. 51), wherein the teacher can instruct an embodied practice, and get the students to see a field of science-relevant detail. The teacher demonstrates a local adequacy that requires a demonstration of practical skills, instead of presenting a reference to a set of scientific knowledge, or relying on any other authentic scientific tools. This shows clearly the occasioned character of teachers' routine way of "teaching by demonstrating"— teaching a sense of demonstration procedure. We can usefully should ask whether this kind of instruction, and the kind of competence it creates, is something for which the reform discourses have anything positive to say.

[Setting II]
The following scene also shows how demonstrations are performed as a practical matter. The setting is the fourth grade science classroom in J school, where the students are being taught about the nature of liquids and solids. The lesson was designed to teach
the students about a "mixture" that is a complex of two or more ingredients which do not bear a fixed proportion to one another and are conceived as retaining a separate existence. In the lesson, the students were also supposed to learn the difference between a mixture and a solution, as we refer to a solution when a substance is thoroughly dissolved in liquid.

The purpose of the following demonstration exercise was to teach the students the method of the separation of the mixture, using simple experimental equipment such as filter paper, and funnel. On the teacher's desk, there are the two beakers -- one contains the mixture fluid and the other is empty -- filter devices, and a glass stick. The following scene shows how the teacher demonstrates as he instructs in the procedure of the separation.

1. T: Now, watch me.
2. See, leave the glass stick obliquely inside the filter.
3. Next, let's get the end point of the filter on the beaker.
4. Let's get the glass stick on the part: and pour: the water: on it.
5. (13.0) ((pouring the mixture in the filter paper on the beaker))
6. See, if you pour too much water on it, (4.0)
7. Watch here. (11.0) ((pouring it in the beaker))
8. Now, don't hurry up pouring it, just slowly: (3.0)

In lines 2-4, the teacher demonstrates how to set up the glass stick in the filter paper. The glass stick is used in order to pour the mixed fluid through it into the filter paper little by little. Then he shows how to put the filter paper on the empty beaker. He pours the mixed fluid in the beaker. In doing so, he instructs how to devise the filtering equipment, how to arrange the angle of the glass stick inside the filter, and how to pour the mixture fluid on it. These steps all proceed as a practical matter. The teacher demonstrates a practical competence with which they build adequacy in ad hoc ways of appropriately pouring the mixture through the glass stick so that the mixture will not tear out the filter.
paper. The teacher's talk, along with the delicate use of his hands, pulls into view the step-by-step procedure.

In a prior class, the teacher had the students put mud into a glass beaker on their group table with six spoons, and had them observe the following change of the state in the beaker. The following scene shows how they watch and discuss the separation of the mixture of solid and liquid. The teacher has found in a student's enactment an occasion to call the cohort together for a demonstration of his own. He walks by one table and picks up the beaker in his hands. Then he turns his attention to the cohort and asks them about the state in the beaker.

1. T: OK, look here!
2. Look!
3. ()
4. See! (.) Watch here, the others.
5. See, what is going down to the bottom?
6. S: It's mud!
7. T: Right?
8. S: Yes.
9. T: When I look through it,
10. I can see small stones and sand in it.
11. See, next (.) see.
12. What is happening in the upper part?
13. S: It became transparent.
14. S: There are bubbles.
15. T: Yes, we can see bubbles.
16. S: It became transparent.
17. T: Yes, it is not entirely transparent yet, but it becomes gradually transparent, doesn't it?
18. S: Yes.
19. T: Right?
In this scene, the teacher’s instructing unfolds in the exchange of question and answer. In lines 1-5, the teacher keeps telling them [“look here,” “look,”], and then he asks the students a question about the state of the inside of the beaker. In lines 6-8, the students respond to the question, and the teacher produces a reformulation of the students’ response in more detailed terms. And then, in line 12, the teacher asks the students a question which is quite indefinite (“line 12”). The students respond to it, and the question receives two different answers. The teacher takes the later one, and affirms it. In line 16, the student repeats the answer that has already been produced but not taken up by the teacher, and the teacher affirms it, with a qualification, and produce from it a next question.

In doing so, in lines 17-18 the teacher moderately corrects the students’ response, and showing a more apt way of saying what they are seeing, [“It is not entirely transparent yet, but it became gradually transparent”]. The teacher’s instruction here is not just about finding out what happens in the beaker. Rather, with this, the teacher shows the cohort a sense of the pace of the demonstration. That is, the teacher shows them about the process of the mixture in progress.

“Waiting and seeing” the results of the demonstration when performing it is a tacit rule for finding in the circumstantial details of inquiry what the lessons shows. In this scene, the teacher and the students see what the lesson shows in the demonstration of the mixture in the beaker and discuss it. Here, the tacit rule of waiting and seeing proceeds not so much esoterically as practically. Such apt reporting has to do as much with the practical matter of how the teacher gets the students to see what the lesson promises in the course of the demonstration, as the matter of how to describe exactly what they are seeing in the materials. Such reporting is embedded in the ongoing procedure of the demonstration, in which they are supposed to wait and see whether this case would be a mixture or a solution. And then if they were to get a mixture instead of a solution, they would perform a demonstration of the separation of the mixture through the prepared device of filtering.
As for the students, they know what the teacher describes about the mud in the beaker at the outset, 'as a matter of simply seeing and reporting a fact.' Nonetheless, the teacher’s demonstration and the ability of the students to collaboratively complete his IRE initiations are tied to what they now know of the demonstration, through their first-hand experience. There seems to be no place for formal sets of knowledge to mediate for them in doing so. The teacher’s instructing the demonstration is concerned with how to teach the procedure and a sense of it. Thus, the procedure is thoroughly practical, and it renders the scene routine, something which can be seen anywhere in everyday science classrooms. It works as a lesson and curricular activity for the teacher and the students alike. When we read proposals for authentic inquiry, how we could do so without following such routines remains puzzling.

There is certainly “inquiry” here, but in the context of the most practical kind of pedagogy. The everyday constraints are not just the institutional ones that appear only in classroom lessons. Rather, they appear whenever we take a look at actual occasions wherein we are teaching someone who is learning a practical skill, for example, to ride a bicycle. It is difficult to say how one would “re-form” such a course of instruction. And if it is so recurrent, to be found whenever teachers enact the instruction of demonstrations across everyday science classrooms, how do we tell which are reformed authentic science lessons or which are not?

4. Learning by enacting demonstrations

Students’ laboratory exercises are also demonstrations. In particular, in most cases, the students’ own demonstrations in the science laboratory are routinely enacted after getting the opportunity to watch the teacher’s prior instruction. In those cases, the demonstration task for students becomes a matter of how to complete the instruction. Here, one of the differences of those cases from teachers’ demonstrations is that the demonstrators themselves should learn or find out something about the instruction in
Amerine and Bilmes (1991) discussed how "following instructions" in elementary science classrooms is a first task and an accomplishment required of the students. In order to depict how the early grade students are enacting demonstrations in the presence of instruction, they attend to the fact that instruction is always indefinite, relying on a Wittgensteinian discussion of rule-following: a rule can never specify the occasion for its use. They observe that how the instruction is completed depends on how the students find a way of turning the teacher's instruction into courses of action, as a practical matter. They describe, through the study of cases, how the students' inquiry consists of constructing a series of practical next-courses-of-action from the instructions given by the teacher.

Successfully following instructions can be described as constructing a course of action such that, having done this course of action, the instructions will serve as a descriptive account of what has been done. (p. 5)

Amerine and Bilmes conclude that for the elementary students as "instruction-followers," the task was how to turn essentially partial descriptions of objects and actions presented by their teacher into concrete, practical activities with predictable outcomes. They observe that the students, in order to do so, had to fit the contingencies which incessantly occurred in the course of actions into the purpose at hand. They find that the students did so without time-out from the course of action to consult extraneous mediators such as sets of knowledge or pregiven rules. If they encountered an unexpected outcome in the course of action, it indicated trouble and warranted some remedy.

In as much as the students were concerned with the fact that the expected should take place, as well as what would take place, their reasoning was as much practical as 'theoretical.' Finding the next course of action and its relevancy to outcomes was a distinct curriculum for the students because “the child is incompetent in the ordinary, taken-for-granted skills of daily life” (p. 325). Their observation brings into view the
accomplished nature of following instructions by focusing on young students as novices to such an exercise.

According to Amerine and Bilmes, the fact that the students have received instructions from the teacher, and the expectation that they would receive instructions, means that the students' own enactment of demonstrations is procedurally produced. To see how it is done, why it is, we need to closely examine a few occasions in the observed science classrooms, and discuss the findings in terms of the reform discourses.

[Setting I]

The following scenes are from the B school class about acid and base solutions. The class was implemented in a science laboratory, where the equipment and the materials necessary for the students' own demonstrations -- a test tube, a tit pipette, three beakers containing hydrochloric acid, sodium hydroxide and phenolphthalein, respectively -- are arranged on each group table. In the following scenes, after the teacher's demonstration of the project, the cohort split into a few groups at their group tables. The teacher's instruction of the demonstration earlier in the session provided a model for the students to follow as a later task.

In the following scenes, the video-camera focuses on a group table, where six students are about to enact the demonstration. Three students sit on the each side of the table: three girls on the one side, and three boys on the other side. Noticeably, the following scenes show that most of the manipulation of the equipment is enacted on the three boys' side, even though the participation of the members on the other side is observed. The group members are working to make solutions of acid and base by dropping, shaking, making a solution and reckoning. In their work, how to re-enact the teacher's demonstration becomes a practical matter of manipulating tools and equipment, along with reading the process of change of the fluid in the test tube, e.g., how to make one drop with the tit pipette, how to handle the equipment, deciding when a solution is acid, when it is base, and so on.
(1) Preparing for the demonstration field

The following scene shows the students finding a way of re-enacting the demonstration. They have heard from the teacher in his earlier lesson a caution that they should keep the test tube dry in order to maintain a rigorous condition of acid and base within the tube. Earlier in this scene, they had washed the test tube and beakers. S1 takes the task first, and he holds up one tit pipette and puts it in the beaker containing base fluid. Watching his way of doing this, the other members find out how to handle the equipment, and they show their findings to each other. They begin the demonstration enthusiastically, without any particular preparation of the demonstration field.

115. S2: Hey guys, let's do it.
116. (0.5)
117. S1: I'm going ahead.
118. (0.5) (...)
119. I'll put in a little. ((trying to put the tit pipette into the beaker of phenolphthalein))
120. S4: Aren't we supposed to put it into tubes?
121. S1: That's right, into the tubes.
122. S4: (We need to keep) the tubes dry.
123. S2: //Hey, we still got water.=
124. S6: =No, (...)
125. S1: The tubes are already dry.
126. (0.5) ((S1 is about to pour the base fluid in the beaker into the test tube))
127. S4: There is water again.=
128. S5: =There's water again.
129. S1: (...) ((shaking the tube))
130. S5: [There is water again.]
131. S4: [There's water again.]
132. S: Hahhh.
133. (1.0)
134. S5: Why don't you shake it at a right angle?

135. (0.5)

136. S6: That's it.

137. S3: That's OK, let's go.

In this scene, S1 tries to enact the first step of identifying the nature of a base in the fluid of the test tube with drops of phenolphthalein. In order to do this, he is about to pour the base fluid in the beaker into the test tube. While he does so, the other members who are watching him speak out about what they immediately find concerning what to do next in the procedure of the demonstration. They are disagreeing, and correcting each other, about the first step: grabbing the pipette vs. ‘preparing the field’ by being sure the tubes are dry vs. “putting it into the tube” (line 120-121). The “first step” is the first question and problematic.

In lines 119-121, S1 is about to put the tit pipette into the beaker containing base fluid, and then S4 tells him what she saw. There, S1 is trying to pick up one drop of base fluid with the tit pipette, but S4 corrects him about when to begin the procedure. Then S1 recognizes what she has told him, and turns his attention to the beaker and test tube. So, their concern goes to how to pour base fluid into the test tube. In lines 122-123, S4 and S2 find still another possible place to begin the demonstration. Earlier, they had heard from the teacher that any remnant in the tube might hinder them in identifying what would be contained in the test tube, and thus it should be cleaned and dried before the demonstration. S4 and S2 find that the tube is not dry, and other members have similar concerns with S1’s continuing enactment of the demonstration. In lines 124-125, S6 and S1 discuss the observation, while S1 prepares to pour fluid into the tube. In line 127-128, S4 and S5 find the tube is not dry yet. And S1 then takes the advice seriously, and begins shaking the tube in order to make it dry, where even the shaking becomes a question of correct procedure (see line 134). In this way, the group is collaboratively and contingently finding the ‘first step’ of the demonstration.

As seen here, as they begin the demonstration together, the first task becomes one of
determining the appropriate place to begin. While they are dealing with the immediate
constraints related to the equipment and the materials in the setting in order to prepare for
enacting the demonstration, they are already enacting it. Even though they had watched
the teacher's instructions for the demonstration, what they are doing here requires finding
out what to do first, and next, and they actually do so as the course of enacting the
demonstration without time-out. What they are doing in preparing for the demonstration
and what they are producing procedurally as the demonstration, do not happen separately.
In other words, they do not produce the demonstration by consulting extraneous
resources, such as a set of scientific concepts or criteria. Without arguing about whether
it will work as the curriculum that the lesson intends to implement, their work is a part of
learning how to enact the demonstration.

(2) Finding a problem

When the members agree that the test tube has become dry enough to begin the
demonstration, S1 fills the rest tube with base, and begins to put a drop of
phenolphthalein in it.

152.S1: Here we go.
153.S2: OK. Go ahead. Who is stopping you?
154.  (1.0) ((S1 is putting a drop of phenolphthalein in the sodium hydroxide fluid))
155.S3: Oh, pinkel.
156.S2: Yes, it's pinkel.
157.S4: Hur? ((seeing that S1 is adding more drops))
158.S2: Hey, shake it, shake it.
159.  (...) ((S4 is taking the test tube from S1 and then shaking it.))
160.S2: Give me that.
161.  ((taking the tube from S4 and shaking it.))
162.S1: Do we need to make its color deeper?
163.S5: Let's make its color deeper.
164.S1 Give it to me. I'll make it deeper.
S1 adds the drops in the tube, and together they are waiting and observing the solution process in the test tube, as the lesson has instructed them. Earlier, the teacher cautioned them that they need to make the drops one by one, in order to let them identify a steady color change appearing in the solution. In line 157, S4 thinks that S1 has made too many drops. But attention turns to the solution, as S2 calls for S1 to shake the test tube. Then S4 takes the test tube and shakes it, and S2 takes it, and he does same thing too. But in lines 162-164, the students cannot see a color change yet in the tube, so S1 asks the members if they need to make more drops. In line 166, S4 cautions S1 again. And in line 169, S2 reminds the other members, particularly S1, about what they have heard from the teacher. He blames S1 for dropping too much, and S4 agrees, and it becomes an exchange of laughter and exaggerated blaming, as S1 suggests that someone else try to do it.

As we can observe here, their enactment of the demonstration does not seem to be oriented to the 'scientific' nature of the fluid in the tube. On the other hand, they already know it is a base fluid, i.e., they have poured the base fluid in the tube earlier. On the other, in organizing that enactment of the demonstration here, they are concerned with how to bring into view the color change that is supposed to appear in the base fluid of the
tube—what the lesson promises as a matter of spectacle. They know the outcome of the demonstration in some sense, but it is in a practical and immediate way that they inform each other in the course of doing it. They find the relevant contingencies in the circumstantial details of handling the materials and recalling their instructions. And in doing so, they encounter a problematic situation— they still do not get the color change that the lesson promises. Before arguing about whether the situation here would be authentic as a scientific demonstration, it is evident that they have a "real" problem here. S1 and the members deal with the situation in an ad hoc way without stopping the procedure in order to consult any other measuring tools. That is, they go on with the demonstration by making more drops until they can identify the color change.

(3) Resolving a problem by requesting help from the teacher

Meanwhile, S1 continues doing the test and observing the inside of the test tube. It seems that the outcome of the color change in the fluid of the tube is still too ambiguous for the students to tell. Then, S1, with the test tube in hand, approaches the teacher who is near the group table, and asks the teacher a question, showing him the test tube.

177.S1: Sir! Is there too much water in the tube?
178.T: Yes.
179.S1: I mean, not water.
180.T: //Look at this. We can see some light color, can't we?
181.(S): Yes.
182.T: It's a weak base, isn't it?
183.(S): Yes.
184.T: We need, right now=
185.S1: =too much=
186.S2: =I see
187.T: [very little] hydrochloric acid. ((in a very faint voice))
188.S1: It has too much sodium hydroxide, doesn't it?
189.T: Yes, it has.
190. Hydrochloric acid is much stronger acid than sodium hydroxide.
191. very much stronger.
192.S1: Yes.
193.T: [So, just one drop]
194.S1: [(...)]
195.T: Eum, just one drop could be too much.
196. So try just a very small amount.

When students find something problematic in enacting demonstrations, they routinely request the help of the teacher. As seen above, they have a problematic situation as much because what has been expected does not happen in the fluid of the test tube as because of what happens in it. In line 177, S1 asks the teacher about the solution in the tube, showing the tube to him. In line 179, S1 corrects what he has asked about. The teacher takes a look at the tube, and describes the color of the fluid. He identifies it as a 'weak' base. Then, in line 184 and 187, the teacher suggests what they should do next. S1 gives a description of the problem in line 188, asking for the teacher's confirmation, and in line 189 the teacher affirms S1's question. In doing so, they come to an agreement that there is too much base fluid in the test tube to show the expected color change in spite of drops of phenolphthalein that were added. In 190-196 the teacher discusses the relative strength of the solutions, and simultaneously he points out the next step, "[S]o just one drop." He shows the group members how to enact the next step of the demonstration, saying a "very small amount" in a faint tone.

What they do does not seem so scientific. Nonetheless, they do so with an analytic sense of how to manage what is happening in the demonstration. And the students learn it in enacting the demonstration. With such an analytic sense, the students find the organization of the demonstration in the contingency of the setting, and thus they find out what to do next. In this way, they build the local adequacy of what they have done, i.e., the students seek affirmations from the teacher as well as in the flow of visible change of the fluid color. Here, the teacher, instead of introducing any measurement tool, sees the
test tube at a glance and then immediately responds to the question that S1 asked. By
doing so, the teacher leads the students to what they will do as the next phase of the
demonstration. By demonstrating his instructions prospectively and retrospectively, the
teacher gets the students to find the next phase of the demonstration — to get a sense of
the procedure of the demonstration as a practical enactment. This shows how the
students resolve the problem. Without relying on any measuring mediator, the teacher is
pulling into view his instructions of what happened and what will happen as the next step
for the students to see. Whether it is authentic or not, the students learn a procedural
knowledge of the demonstration.

(4) Learning by doing — Discovery learning

Once instruction is given, the instructor watches what will happen. Here, as the
lesson continues, the teacher demonstrates an instruction about what to do next. S1 takes
the tube from the teacher and he is about to put the tit pipette into the acid beaker. The
group of the students, in the presence of the teacher, are watching the spectacle of S1
putting a drop of the acid fluid into the test tube.

197.S5: =Let's do it now.
198.S2: Yes sir.
199.T:  I mean hydrochloric acid.
200.S1: Here?
201.T:  Hur?
202.S5: Try a little, just very little.
203.  ((S1 takes the tube from the T))
204.T:  Try it, which one is hydrochloric acid?
205.S1: This one is hydrochloric acid.
206. = Wait!
207.S6: This one was hydrochloric acid.
208.  (I.O)
209.S5: Just a very small amount.
In line 204, the teacher's question is not a typical mode of question with known answer. Its syntactic mode takes the form of a question, but it is used to lead the student to see a mistake he is about to make, in identifying the acid beaker. S1 responds to the question from the teacher, and immediately repairs his answer, and S6 confirms the correct identification about which was the acid fluid among the three beakers on the group table. S6 has been holding her right to respond to the teacher's question, and this shows collaborative work among the group members as well.

S1 puts a drop of a fluid in the test tube and then shakes it. Then, they wait for the fluid to spread throughout the tube, watching and commenting on the spectacle together. The measurement of the appropriate drop of fluid requires delicate manual work. The teacher and the students alike are giving their attention to the way that the student uses his hands. Then, using the tit pipette, S1 sucks one drop of acid from the beaker containing the hydrochloric acid. While S1 makes drops into the tube, the students are watching the performance. They produce animated expressions, ["OK, OK, Don’t move," "Go, go fast, son," "there it goes, there it goes"] S1 describes the material as if it were an animated character, and both comments and silence together are produced while they are observing the solution in the test tube.

As they are organized within hearing range of each other, their talk develops very delicately, tied to the order of the material array. Without reference to an objective
system of measurement, indexical expressions are made available to each other. They are produced to make the material array transparent and also to make their utterances intelligible, reflexively. And then, in line 215 they collaboratively produce a moment of pause, watching the spectacle together, which continues until S2 breaks it by describing what is going on within the test tube, ["Wow, it is spreading"]. Their activities of talk and action are deeply interwoven with the material array of a drop of fluid and synchronized with the course of its flow.

This may show an evident example of "discovery learning," which we can identify through their remarks. They are ‘narrating’ what they are seeing, and, in this sense, and in the presence of the teacher, they are doing something like ‘witnessing and reflexively constituting’ the demonstration field. In the teacher’s presence, they can ‘see’ what it is that they are supposed to be ‘getting.’ Their comments are basically saying, ["That’s it"]. They are producing the results the demonstration promises, as a course of action. It may be that this is what “discovery learning” or “inquiry learning” or “learning by doing” is talking about.

If so, it gives us a basis for speaking of those things in a slightly different way -- we can see how their hands [and bodies -- “don’t move”] are implicated in the in situ production of the demonstration field. Presumably, that is why they say “Wow.” It is, in this sense, a different “wow” than the one they uttered when they were watching the teacher do it. It shows that they have found a procedural sense of the relevance between the solution process and what the instruction promises, while they were involved in enacting it. Presumably, this is so familiar that it is routinely observable across science classrooms. If these features of discovery learning appear in very familiar and mundane ways, then perhaps discovering learning is already a part of everyday classroom science demonstrations.

(5) Learning by doing -- Reading the material in the material

Discovering what happens in the test tube, the students together find the adequacy of the outcome and what to do next. The continuing scene shows how the students measure
what they are doing as and in the circumstantial details of the change of the nature of the fluid.

219. S1: It became a little weak.
220. S4: [Why don’t you try a little more?
221. S5: [A little more.
222. S1: It looks transparent except for the upper side.
223. Give me that. ((S1 takes the tit pipette from S4))
224. ((S4 takes the tube and looks through it))
225. S5: Why don’t you try a little more?
226. S2: //Let me do it. ((S4 takes the tit pipette from S1 and puts it into the tube))

The students are not looking for objective criteria to determine the nature of the fluid. The only criteria available to the students in the setting concerning measurement are to make a drop and see the following color change in ad hoc ways. It does not seem that there is a tool with which they can measure the material array in this scene. Instead, the fluid and the color change in it are both an object upon which the measurement is applied and a means for measuring.

One might argue that such actions are trivial or peripheral to what they are supposed to learn about the ‘topic’ of the curricular knowledge such as a principle or a concept. This implies that mere actions on the surface structure would miss what happens in deep layers. The activities in the classroom lesson seem to consist of the sequential organization of such actions which could seem as trivial. Is there anything else other than those?

This case shows an occasion in which the measurement as practical actions is relevant to the local organization of actions, and thus makes what the students have done intelligible to each other. They have already been informed, and thus expect how the fluid in the tube will turn out after dropping in the other fluid. For the students, how to proceed in the demonstration is a matter of how to read the immediately emerging
environment in the course of actions in such a way as to find a match between it and what
the lesson promises.

The scene shows the establishment of a local relevancy in which textual indication for
actions cannot be found anywhere else. The course of action proceeds within indexical
terms and deictic reference ["shake it," "it became a little weak," "too upper," "take it
close to the tube," "try a little more"]: They over-determine the field with practically
appropriate methods which are reflexive to the course of actions. Instead of complaining
about whether it should be considered authentic or not, we can find that it works as an
actual curriculum for children successfully. Yet, while what is evident in this scene is
that they jointly find the next action as a practical matter in the course of the
demonstration, how they can get a generalized sense of the related scientific principle
from what they have done in the demonstration remains to be seen.

(6) Learning by doing – In the presence of instructions

Instruction for appropriate tool use is a very common feature in the school science
lab. The teacher gets the students to comprehend his instruction, by demonstrating how
to handle the equipment. In the continuing sequence, as the teacher watches the group
work, he abruptly intervenes.

227.T: One drop = just one!
228.  (0.5)
229.T: No, you dropped it in too much in the upper side of the tube.
230.  Give it to me for a second. (.)
231.  If you put it in the upper side with the tit pipette,
232.  there’ll be nothing left to fall, right?
233.S:  Yes.
234.T:  So we need to take it close to the fluid.
235.S1:  Aha.
236.T:  Go with this and make one drop on the wall, like this.
237.S2:  I see.
238.T: Try again.

This segment shows the teacher further elaborating the technical, practical skills of how to pick up a drop of the fluid from the beaker with the tit pipette and drop it into the test tube in order to make a solution. He takes the pipette and the tube from S1, and demonstrates a new technique for controlling the pipette to make a drop fall in the tube. Talk is arrayed with bodily precision, so that the witnesses see and hear the scene in that way. S1 and S2 are watching the demonstration and indicate what they have found in it.

This shows an occasion of "learning by doing," where what is to be done is nothing so formal as 'science,' but rather an entirely practical embodied competence, like building a fire, or tying a knot. The teacher is bringing features of the tasks in practical, circumstantial detail into view for the student. He is showing the students what they must be seeing as they performs the task, for which their efforts and inquiries so far are a curricular resource for the continuing instruction. Their 'learning by doing' is a resource for the teacher too.

(7) Learning by doing — Collaboratively making sense of the demonstration

The following scenes are concerned with the student group's enactment of the demonstration in the absence of the teacher. They show how the students make sense of their most recent instruction, and figuring out collaboratively what has happened and what to do next.

265.S1: Inho! You do it.
266.S2: Hehe, what am I supposed to do? ((being embarrassed))
267.S1: With this, (...) ((trying to take the tit pipette from S4))
268.S4: Let me just do this, wait, wait, wait.=
269.S3: =Hey, what are you doing?
270.S1: Like this, take it very close, [and make a drop.
271.S2: [Huh?
272. S6: //He's already seen that.
273. S1: Make just one drop.
274. (S): (...) 
275. S3: Closer.
276. (0.5) ((watching S2's work together))
277. S1: Stop. Oh, you made two drops.
278. S3: It's three drops.
279. S1: It'll be too strong. ((S1 takes the tube))
280. (0.5) ((S1 shakes the tube))
281. S1: It looks completely transparent.

Here, S1 hands the tit pipette over to S2 to practice the new technique just demonstrated by the teacher. Given the materials, S2 is at a loss about what to do. Then, S1 demonstrates to him how to use the tit pipette and how to make drops in the test tube in the new way. He does so, discursively pulling into view how to enact the demonstration, ["With this," "Like this," "Take it very close"]. They talk to each other over the course of S2's manipulation of the tit pipette. They watch S2 picking up acid fluid and putting it in the test tube, and show their concern about the way S2 is enacting his own demonstration, saying, ["Make just one drop," "Closer"]. Together they watch S2 performing the demonstration, and they immediately find that he is inappropriately making too many acid drops into the tube. S1 sees this, and says how the drops influence the solution in the tube, ["too strong," "completely transparent"].

This scene shows the feature of collaborative learning in enacting the students' own demonstration. As a feature of their collaborative learning, what is available to the group of students in talking to each other in the setting is not highly calculated experimental manipulation but a far more practical awareness of circumstances and ordinary actions. Their collaborative talk and the course of their hands' activities are arrayed together. They are showing a sense of the procedure prospectively and retrospectively -- a sense of what should happen in the immediate next and what happened in the immediate past -- by
means of which they help their colleague student S2 to perform the demonstration and to learn how to do it. To watch and talk are reflexive to the flow of the setting in that the former builds the latter and simultaneously the latter shapes the former. If these features are seen as an evidence of the stable routine of classroom lessons, regardless of whether the setting is reformed or not, it could be because they are the setting-specific practical characteristics revealed over the course of the event.

Collaborative learning in enacting the demonstration is embedded in the exchanges of the vernacular talk in instructing, following instructions, blaming, and praising among the group members. In other words, the procedure of dealing with the contingencies encountered in the course of the demonstration takes place not only in such the exchanges of actions, but also as exchange of them. Similarly, in the following scene, the group demonstration continues. The group of students are watching and speaking while S2 is making the solution in order to change the fluid in the tube from acid to neutral.

312. S2: My name is big mouth, big mouth.
313. One drop? ((taking the tit pipette from S1))
314. Only one drop. I’m scared.
315. (S3): It’s all right, hehh.
316. S4: Huh?
317. ((S2 puts drops into the tube))
318. S4: Hey, it’s not Hydrochloric Acid.
320. S1: (You’ve said) you wanna try.
321. S2: I have to drop much?
322. (.)
323. Shall I drop all of it?
324. S3: This is too small.
325. S1: //Wait a minute!
326. This is it, right? ((pointing at the beaker))
327. [Sodium Hydroxide]
328. S: [Sodium Hydroxide]
329. S2: Shall I drop all of it?=
330. S1: =Yeh.=
331. S2: =Shall I?= 
332. S1: =Yeh.
333. ((S1 takes the tube from S2 as soon as he has made some drops))
334. S3: We may need much more, we
335. ( ) //We need much much more.
336. S3: We need lots in order to make it pink.
337. (1.0) ((S2 putting some fluid into the tube))
338. S2: Shall I put all of it in?
339. (1.0) ((making drops))
340. S1: Hey, Stop = stop.
341. (.) ((looking into the tube)) Gee!
342. S: Hehhh.
343. ((S1 taking the tit pipette from S2))
344. S1: It's too much.
345. S: Hehhh.
346. S2: It was just my mistake, really.
347. S3: Inho! Everyone makes mistakes.
348. (2.0) ((S1, making drops and shaking the tube))
349. S2: Gee, we are supposed to make it a neutral?
350. S4: Yeah.
351. S2: They said they made pink, huh?

In line 312-317, in beginning to make the solution, S2 is joking and showing his nervousness in dealing with the material. The others try to make him feel relieved, and encourage him to go ahead in making the solution, in lines 318-320. In lines 321-323, S2 shows his uncertainty as to how many drops to add, and in line 325 S1 abruptly interrupts S2's enactment and poses a question about whether they put the right fluid in the pipette in the beginning of making the neutral solution. Then a group member immediately
responds to him, and gives an affirmation (line 328). In doing so, they show their concern about the procedure, indicating that they are still involved in the course of the procedure.

In lines 329-333, S2 continues to show his concern about how much base will be needed in order to make the solution they intend. S2 and the other students are speaking among themselves, and S2’s delicate manipulation of the tit pipette is supported by their talk. While they talk with each other, he is learning how to use the equipment delicately and how much base fluid to put in, in order to get the intended solution.

Again, the group members are watching the way S2 uses his hands and the movement of material. Their attention turns from the pipette to the test tube, with proposals to add more acid to it (lines 333-337). S2 then adds more drops, and they sense that S2 is making drops too many in the glass tube (line 340). They sense the possibility of a failure. What is a failure, here? Their concern has been with performing, waiting and watching what the outcome will be. And they do not find such a failure according to any measurement tools for acid or base. Instead, they measure the demonstration and how to identify it with what the lesson promises, while reading the color of the material in the tube. It is the witnesses’ sense of the procedure, [e.g., line 336, “Stop stop,” “It’s too much”].

In 349 and 351, S2 apologizes what he has done, and shows he has misunderstood what the group of students have said to him. His utterances here show what he has been confused about is more than a matter of a match between “neutral” vs. “pink.” He might understand the scientific concept, or he might not. But it is evident that vernacular terms have organized his understanding. In this way, the students are collaboratively making sense of the procedure, and this shapes the curriculum for the students in the science classroom.

The scene above demonstrates the routine character of student-time, including fooling around, blaming, joking, exaggerating, pretending, and being embarrassed. These students behaviors render the scene familiar, possibly in two senses. First, it may be recurrent across the settings. And second, it may be outside of what some regard as
"authentic" science learning. Nonetheless, we could ask, without such features, to what extent could "authentic" science learning by collaboratively enacting demonstrations take place in early grade classrooms. Along with such activities, these young students find the relevance of the contingencies of what the lesson promises without abandoning their lives as children to look for decisions about what the contingencies are or how they should be treated. 20

In other words, there doesn't seem to be a time-out for their life-world to decide on their next actions. In classroom task time, the success and failure of their actions take place only in the course of ongoing actions. The students do this by making use of the contingent features such as materials, scientific terms and vernacular terms at hand in the setting. Sometimes, the unexpected outcomes in their work indicate a problem and require some remedy. Attempts to re-mediate all take place without pause and without escaping the local context of ongoing actions. The students do this immediately but analytically. In this way, they make sense to each other of the demonstration procedure that they are enacting. This is very familiar in science classroom lessons.

In the scenes observed above, collaborative "learning by doing" takes place as a way of finding local adequacies, in which the students' actions provide immediate environments for their next actions, and build immediate evaluations based on the needs of their previous and next acts. Such collaboration is different from discovering the adequacy of goal-directed actions by consulting formal, extraneous criteria. If we seek a model of authentic collaborative learning in demonstrations without taking the nature of the practical circumstantial details as a condition of collaboration into consideration, we may be puzzled about how it would be constructed. Rather, the practically organized

20 This way of treating a mistake or a failure in the setting of collaborative work may be different from adults' way of doing so. It is a routinely observable characteristic in the everyday setting of children's play (Corsaro, 1988). Adults usually make use of ambivalent or delaying tactics such as "well" to mitigate their way of expressing direct opposition or criticism (Lerner, 1996).
collaboration in this scene shows the joint construction of demonstrations in science classrooms, wherein we can find a different measure of “authentic” collaboration, for instance, “in the sense of sharing of ideas, joint evaluation of information, hypothesizing and decision-making, or even taking any advice offered” (Mercer, 1996, p. 366).

(8) Resolving a problem by requesting help from the teacher — Finishing the demonstration

Students’ demonstration activities are invariably constrained by the lesson schedule. Lesson time is a relatively fixed time for both teacher and student alike. The “timed nature of the classroom lesson” appears through the participants’ commonsense knowledge about routine lessons. This is also pervasive in the students’ enactment of the demonstration, and we can observe how the teacher’s and the cohort’s common sense of time use could shape the form of the demonstration activities which they are engaged in.

Here, the group of students are deciding when the fluid is neutral. Immediately before the scene above took place, the teacher was talking about what would happen at the group tables. Then the teacher pushed the students to complete their task soon, yelling at the whole cohort from the front of the room. While the talk among the students in the course of actions proceeds, S1 continues to play a leading role in doing the demonstration task.

366.T: Let’s, let’s finish in two minutes.
367. Make a neutral fluid in two minutes.

The authenticity discourse often assumes that, in Vygotskian terms, a “more competent peer” must provide the “scaffolding” support for a learner. Brown et al. (1989) note this concern:

Students who are taught individually rather than collaboratively can fail to develop skills needed for collaborative work. In the collaborative conditions of the workplace, knowing how to learn and work collaboratively is increasingly important. If people are going to learn and work in conjunction with others, they must be given the situated opportunity to develop those skills. (p. 40)
368. (((yelling at the front of the room)))
369. S4: Make it completely red.
370. S1: What’s this? I told you to make one drop.
371. Why did you do two drops?
372. S2: Hey, Young! Count two minutes.
373. S5: I left my watch at home.
374. S2: Hey::!
375. Mr. Kim has always meant just one minute by two minutes.
376. Last time, he was supposed to count five minutes, but...
377. ((S1 takes the tube to the teacher and asks him about something))
378. T: Attention! Attention!
379. Stop your experiment, and attention!
380. Even though we thought we made a drop with the tit pipette very
381. accurately, scientifically speaking, it was considerably rough,
382. wasn’t it? Accordingly, we can’t decide when it is in
383. a perfect neutral condition, with our naked eyes.
384. (S):(What can we do..)
385. T: So, we are supposed to make just something like neutrality.
386. As you see, just one drop of dilute hydrochloric acid made it
387. too strongly acid, right?
388. S: Yes=.
389. T: =So, if we put in more sodium hydroxide, we can see light purple
390. at some point. We can regard it as very weak base, right?
391. And then, let’s consider this some neutral we made. OK?

After the teacher’s announcement in line 366, S4 tells about the next thing they are
going to do, by articulating the final state of the neutral fluid in line 369. In doing so, she
shows to the group members her concern that they should complete the demonstration
soon. In 370, S1 blames S2 for not following his instruction. On the other side on the
table, S2 tells another girl to keep time, and complains about the teacher’s instruction
concerning the time allocation, referring to what they have experienced as a member of
the classroom in this setting the last time. In this way, they acknowledge to each other that they need to hurry up in getting the solution of neutral fluid.

Then, S1 approaches the teacher with the tube in his hand. With the video-audio camera, I could not catch what they were discussing there. Presumably, he asks the teacher about the current nature of the fluid in the tube which they have worked on. We can guess so from the earlier scene that has described their concerns about when they should stop making the solution, and what color is supposed to be the end-point which the students should arrive at. After a moment, the teacher quickly turns his attention to the whole class, and resumes the whole-class lesson.

In line 380-391, the teacher gives the cohort an explanation about how to discover the nature of the fluid as a neutral. It is not a method for exact measurement of a neutral. Rather, the teacher instructs the cohort to find when the fluid in the tube would be approximately neutral, which then resolves the task they are working on, in the case of S1’s. While the teacher is giving the instruction to the cohort, he gets the students to finish their demonstrations, by fitting the demonstration to the practical contingencies of the room: They will treat the desired color stage ‘as if’ it were a neutral solution.

This scene might then show the limits of the ordinary feature of classroom science lessons. The teacher, within a fixed schedule, has to manage multiple groups in the cohort which might work on their projects at different speeds and even with different tasks. However, such limits seem irremediably indispensable in the setting in some sense. First of all, the students in this scene have their task in a double sense, as seen in this case. The one is to complete the task at hand; the other is to reckon the teacher’s count-down of time. These two are interwoven in the ongoing classroom practice, and thus the teacher’s time pervades intrinsically the students’ activities. It even organizes criteria of adequacy, as we see above.

As a matter of fact, the social constraint of such a time schedule is a constitutive one that influences the students’ enacting of the demonstration. The teacher’s task is to make the classroom demonstration observable as if it happens naturally, and by the clock. A time concern is one of the constraints for teachers in instructing demonstrations. It is also
a resource, in organizing the lesson, monitoring its course, and deciding its completion.

The authenticity discourse has discussed the possibility that such institutional constraints of schooling could limit the students in the pursuit of more authentic inquiry activities. However, when we take a look at competent members' "authentic" work in science, we find that the institutional constraint is not only a limit of schooling, but it also appears in the routine of the science lab culture. For example, Ochs and Jacoby (1997), describing the timed nature of laboratory work, point out that career schedules, project cycles, conference deadlines, and daily contingencies form the cultural clock of working scientists. They show through the description of a particular case how the time pressure of a coming conference resolves particular remaining disagreements about matters of physics among the researchers.

In some sense, we could say that time is not only a means to organize scientific products, but also an aspect of scientific products itself, and in this way the work schedule of persons deeply engaged in doing science is a constitutive feature of the scientific work. In the lab culture, time is not only an object that scientists measure, but also a cultural artifact that organizes their work. The time constraints on classroom science demonstrations may be less foreign to more authentic ways of conducting lessons than we imagined.

In the scenes above, we can wonder if the teacher is transmitting a set of scientific or proposition knowledge. The lessons are demonstrated as a practical matter in the singular classroom environment. Here, the term, a "singular" setting implies that the methods of demonstrations of lesson are not separable from the distinctive culture of the classroom context in which the procedure of an event goes on, just as Boyle in the 17th century had to be concerned with the very characteristics of the public space in order to operate his new machine. Along with local order of the circumstantial details, the students do learn a kind of virtuosity. The virtuosity is a vulgar kind of competence in many ways, and is demonstrated as a thoroughly practical one, but this does not mean that all vulgar competence is less virtuous. For without learning such virtuosity, one does not even know that there will be contingencies in the course of demonstrations. Thus, instructing
the demonstration and learning by reproducing the demonstration become a distinctive curriculum for teacher and students alike.

[Setting II]

The last scene is taken from group work in P school. The students are studying electric circuits and the principle of electric current, by identifying how the bared wires provide a pathway for the electric current.

(9) Learning by doing – Collaboratively building a model

For this demonstration, the students arranged the materials of dry cell, bell wire, flashlight bulb, and switch device as shown in diagrams that are presented in the fourth-grade-level textbook. Four students are making the electric circuits in the presence of the teacher, and their task at hand is to light up the bulb and then understand according to what principle the circuit works. The bulb only lights when properly connected to a battery. And given the switch, current circulates around the circuit in a given direction, and the circuit only functions when the switch is closed.

In this scene, two students are manipulating the circuits, and the others are watching. The teacher, sitting by the table, gives instructions to the students and watches over how they make the circuit. This shows the work of “learning by doing” in collaboratively making a construction.

27.T: If you are finished it, help him.
28. (0.5)
29.S1: Wait = Wait. Connect with these two.
30. The bulb.
31. Here.
32. (0.5)
33. Watch this, watch this.
34.T: You need to watch closely. Yes, Jun.
In this scene, S1 has just finished his circuit, and then he is asked by the teacher to help S2 (Jun) to build his circuit. S2 has shown a difficulty in constructing the circuit. In line 29, when S2 tries to connect the battery with a wire, S1 interrupts him. S1 hands over a wire to S2, indicating with the wire in hand the part of the other wire which he should connect. And then, without waiting for S2 to complete connecting the wire, S1 himself shows S2 how to connect the wire with the other wire, saying ["Watch this, watch this"]. The teacher also advises S2 to watch S1’s demonstration. In line 35, the teacher praises S2, which is also marking the completion of the construction of the circuit. His praise is also marking the completion of the construction of the circuit.

The collaborative building of the circuit proceeds as a practical matter -- giving direct instruction along with the indexical role of the expressions; the practical competence to hear and follow it; the demonstration of practical skill to handle the equipment of electric circuit. As the textbook proposes, while the students work on making the electric circuit, they may learn the scientific principle regarding how electric flow runs. Or they may not. Nonetheless, it is also obvious that while they are engaged in the practical work, they experience the craft procedure and practical skill of making the circuit. When teachers purpose to let the students in the early grade science classroom experience “learning by doing,” this kind of scene will be recurrent, in a familiar way. Similarly,

36. S1: Turn on the switch.
37. The battery is too weak.
38. T: Let’s see.
39. S3: The battery is weak.
40. T: Weak?
41. If so, (we need) another battery.
42. (0.5)
43. S2: I see, the battery is weak.
44. (S): (...) 
46. (3.0) 
47. S1: Try to put this on, try it. 
48. Here. 
49. (1.0) 
50. Turn it on. 
51. OK.=
52. S3: =[OK]

S1 still takes a leading role in constructing the circuit in the group table. In lines 36-37, while S1 is talking to S2 about what to do next, S2 connects two wires. Then turn on the switch of the circuit, and they find the bulb is not lit. S3 then reports to the teacher his diagnosis that the battery is weak, and the teacher seems to accept it. In lines 42-44, the teacher and S1 are searching for a battery pack in a box, and pick up a broken one, and in line 45 S2 sees it and says ["Huh? It slipped out"]]. Then, S1 finds another one, and hands over it to S2, indicating to him to connect it. S2 has trouble doing it, and quickly S1 holds S2 by the hand, and connects the circuit. They turn on the switch, and the bulb is lit.

This shows a case of "learning by doing" as a practical matter -- how to connect the wire, how to devise the switch, and how to diagnosis a problem and decide its resolution. They build the circuit in ad hoc ways, watching what happens and immediately dealing with it without time-out, rather than consulting the scientific principle about how electricity works. While this scene shows practical work in early-grade science lessons, we can find in it features of "learning by doing."

They experience learning by doing, in particular, in collaboratively constructing the procedure. The teacher's or the students' discursive actions and direct instructions illustrate what to do next, what happens, and what has taken place [e.g., in lines 47-52]. They prospectively and retrospectively indicate the procedure of the construction of the
collaboration is constructed in a way that their actions provide immediate environments for their next actions, which build immediate evaluations, and projection of next acts. Learning by doing is routinely experienced in such joint constructions in the mundane setting of classroom lesson. In this way, they experience procedural knowledge. We could then ask if it is a feature of authentic learning or an ordinary activity that routinely appears when students are engaged in making a science model while following their instructions. If it is an ordinary scene, but shows the features of “learning by doing,” we need to reconsider what “authentic” learning by doing would be.

5. Discussion

This study has pursued the question of why it is so difficult to implement the teaching of authentic open-based inquiry which has been part of the central repertoire of instructional reform. In order to find a possible answer to this question, this study began the examination by attending to the explanations presented in the social studies of science about how a demonstration is different from experimental activity. According to such explanations, we could say that most scientific experiments, as known to the public, are a demonstrations. A demonstration is enacted as a matter of a social construction in that in the demonstration the demonstrator displays the procedure in a way to reproduce the legitimate scientific knowledge or experiment, as he displays his own virtuosity with it.

Taking the nature of such a demonstration into consideration, we can raise a question about the authentic pedagogy discourse. In the authenticity discourse, in general, the theoretical model of the work that a competent member in the science area would usually perform in his/her science laboratory, known as a scientific experiment, has played a role in planning models for authentic science pedagogy. Meanwhile, the authenticity discourse seldom takes the nature of a demonstration of actual scientific work into consideration. When we do, we see that “experimental activity” as enacted in science.
classrooms is recognized as a pure case of a demonstration. Indeed, the reform discourse, whenever it is issued, has been willing to accept as a persistent repertoire the teaching model of the open-inquiry based lesson, in which the students are involved in an inductive way, motivated by curiosity about scientific principles, and teachers take the role of providing guidance for them in doing so.

When we consider the nature of a demonstration, the difficulty in implementing the open inquiry-based lessons is predictable in some sense, though the discourse of the repertoire has persisted. However, when we take the characteristics of a demonstration into consideration, we can find a different view of the science classroom practices. This study examines a few cases of demonstration in elementary science classrooms in two facets: the teachers’ first instructional demonstrations, and the students’ learning by enacting demonstrations themselves. While they are involved in the activity, teachers are concerned with how to pull what the lesson presents into view in order for the students to see it in the context of the demonstration’s circumstantial details. How to find out what the lesson promises is found in the contingencies that happen in the context of its practical enactment.

The teachers enact instructions of the demonstrations in order to teach “knowing-how,” including the procedure of the demonstration and a sense of it. They are implementing the teaching by showing how to do the demonstration. While the teachers enact the teaching by showing this, even the teacher’s discourse turns into a constituent part of instructing the demonstration. That is, the teacher’s narrative has to do not just with transmitting sets of knowledge but with constructing the material assemblage with the movement of the material and the use of the equipment as well.

The discursively managed features of the demonstration field make the instruction of classroom science possible. Yet, it is those same features that render the situation observable and reportable, and thus teachable, that the reform discourse is most critical of. Within the managed field of demonstrations, there is no way that the participants, like an apprentice meat-cutter, can ruin an expensive side of beef, or like an apprentice ironworker, can unintentionally injure another worker. Instruction by demonstration
shows clearly how teachers show novices their lessons, and how to do them. It is difficult to find the relevancy for schoolteachers in the early childhood science classroom, of the grown-up organizational frames of after-school science.

Although instruction is so pervasive, even in student time, it is always incomplete. That instruction is always incomplete means that, for example, while mastery of a new machine begins with instruction or a manual for using it, the mastery of instruction needs a machine with which one can actually work. The ability to follow the instruction of a hands-on project or activity always depends on the students' competence to the tasks. That is, only through interpretive work based on their background knowledge of the instruction are the students able to follow the instruction.

I have described such work as features of the social organization of "learning by enacting demonstrations" in the presence or absence of the teacher; the students' finding the next step -- and its relevance to the lesson as a practical matter, in the situation of the demonstration where instructions and knowledge about outcomes of the demonstration are already presented; finding a problem and resolving it; learning to handle equipment; reading the procedure in the nature of the material; collaboratively making sense of the procedure; finishing the demonstration by making use of the social constraint of time; constructing a practical work, and so on. In such ordinary scenes, we can find features of discovery learning, not so much as a matter of inductive reasoning, i.e., reasoning from the findings to the respective general principle, but as a matter of discovering what the lesson has instructed in the course of the demonstration.

The reform discourse may treat the observed features here as the social organization of institutional constraints of schooling, and it may take issue with their authenticity in teaching and learning the science curriculum. Nonetheless, such constraints are not just constraints of the social organization of schooling. The social studies of science illustrate that scientific work is invariably embedded in occasions wherein competent members work with vulgar competence and vernacular talk at the lab bench. According to them, science can be represented neither as a unified form of method nor as a set of knowledge. The social studies of science figured science as a contingent achievement of situated
actions which require technical skills, rather than mastery of unified methods. Such observations about vulgar competence and vernacular talk in science work does not mean that scientific work is the same as other ordinary activities. Instead what it meant is that as the competent members' science work proceeds, it is embedded in ordinary activities.

It might also be argued that the observed features of demonstrations in science classrooms might be peripheral to the "ready-made science" which is to be transmitted via textbooks and examinations. Nonetheless, a classroom is a public space in which demonstration by the teacher proceeds in such a way that the setting and "learning curriculum" (Lave, 1990) which the students can actually experience are inextricably intertwined. In the cases observed above, ensembles of materials, equipment, precision skills, persuasive discourses, and paced bodily movements build instructing and enacting demonstrations in science classroom lessons. This invariably is done in ad hoc ways.

Vulgar measurement, engineering, over-determination of the phenomenal field by shouting, jokes, bodily expressions and immediate actions, all these constitute aspects of the demonstration of a science lesson in the classroom. Along with those features, the students experience a curricular exercise, and without those features, it is difficult to imagine how else the students would enact their own demonstrations.

In conclusion, this study observes the following two features in demonstrations in science classrooms. First, the teachers' demonstration is to teach by showing — by pulling the procedure and a sense of it into view. And the process itself is thoroughly practical. There is no way to teach "knowing how," without doing so. Second, the fact that the outcome of their demonstration is already presented to the setting or known by anyone in the room will not account for or determine the situated actions of performing the demonstration, depending on how the students identify what the lesson shows. These two features often become the targets of the critiques in reform-minded efforts for authentic pedagogy. The critiques treat them as social constraints imposed by the institutional context of schooling. They propose plans that social interaction and practice should be encouraged and mediated with the authentic features of science, e.g., authentic tool use supported by scientific discourse.
But our descriptions suggest that students would then be required to stop the course of action, and then go outside of it, in order to consult authentic mediators such as sets of knowledge or scientific tools. Instead, this study observes how they perform demonstrations in the course of ongoing actions using local measures of adequacy and common understanding. Demonstrations are performed as a practical matter, and their characteristics are recurrent across the settings, which renders the activity ordinary, routine. Nonetheless, learning by discovery, learning by doing, measuring, and instructing are accomplished in it. Demonstrations work irremediably as lessons and curriculum for teacher and student alike.

A demonstration is a routine feature of science lessons. Rather than referencing formal scientific knowledge, the relevancy of action and discourse in it is tied to the situated production of the demonstration. The teacher's authority and his/her talk-managed organization of the phenomena field are not just the teacher's achievement, i.e., students are engaged in jointly producing their instruction, as the demonstration. We could possibly observe similar scenes over and over. Owing to their familiarity in science classrooms, we view these scenes as routine. If so, then, is there any possibility of implementing authentic science teaching and learning in and as everyday science classrooms, without these routines at all? A demonstration entails a practical procedure and a practical sense of it, without which we wonder how one could teach and learn the procedural knowledge. Without them, how could the students, in their activity, learn what the lesson promises?
CHAPTER 6

DISCUSSION AND CONCLUSION

Nearly four decades ago, Goffman (1963) argued that the realm of activity generated by face-to-face interaction had never been sufficiently treated as a topic in its own right in the disciplines of social science. He pointed out that the organization of "the field of public life" is no less than the place where social order is generated. He claimed that public order could be studyable, in domestic, restricted places as well as in widely accessible public places. The school classroom may be considered a relatively inaccessible public place for non-members of the classroom. Here, what is meant by 'inaccessible' is twofold. First is meant that the classroom is not accessible to a stranger who is not a member of the school community. Then, second is meant that the matter of inaccessibility to such a place tends to render what actually takes place in the classroom private, so that the classroom can be characterized as a "black box."

This can be seen when one considers classrooms as a locus of cultural transmission, a place where the young generation prepares for the social world outside of the classroom. Here, various theoretical considerations of cultural transmission tend to take interest in what is going on in the classroom setting, which then is treated as a resource for theoretical discussions. The puzzles of theoretical inquiry seem to be built by the very fact that the classroom is treated as a "black box."

However, when we take a closer look at the concrete situation of the classroom
setting, we find that the classroom lesson is far more transparent. If one enters a room called a classroom, one finds children gathered in a fixed space regardless of whether they want to be there or not. The participants are involved in a social relationship of two parties, where one is the teacher as a single adult member, and the other is an age-grouped cohort. The cohort, 30-40 children, are seated side by side. They have a schedule to follow, regardless of whether it might be flexible or not. Chatting with the neighboring students, students are waiting for the teacher’s instruction about what will happen next. As Philip Jackson (1968) showed in his descriptive study of American classroom culture, the classroom is a place where things happen not because participants want them to, but because it is time for them to occur. This is the “normal” shape of ordinary classroom lessons.

School reform movements tend to reflect a public image of ideal school education, criticizing the gap between what is believed to be the official business of the public school as an institutional setting, and what is going on in the actual settings (see Becker, 1972). As Sharrock and Anderson (1982) observed, “just as in courtrooms the waiting, rather than the trial, can be seen to take up the time and effort, so in classrooms the struggle-for-control rather than the teaching can be seen to be what is important” (p. 182). The instruction in classrooms seems to require more than is manifest as the official work. And yet were it not for the ‘unofficial work’ of classroom lessons, we would have no clue about how the classroom lesson could take place. The question of how to settle on a new form of classroom instructions has much to do with how to un-do the routine, and ignored, practices of classroom lessons.

In Korea, there is much concern about why schools are not easily so transformable. People are cynical about the culture of the out-of-date style of classroom lesson, so they complain: “In the classroom of the 19th century, the teacher in the 20th century teaches the children of the 21th century.” People have given much attention to the larger socio-cultural contexts of local classroom settings. As a matter of fact, social transformation has brought change in the school classroom, e.g., technology use, textbook formats, learning materials, classroom equipment, classroom size, and so on. Older teachers have
also been replaced by another generation of teachers, as well as a new group of students. In particular, they are the generation who never experienced the colonial period or the Korean War. The sociopolitical circumstances have created a more democratic mood, and the effort to rehabilitate the national identity has increased. Progressive voices are gaining power, and ideas about educational reform have slipped into public opinion through the mass media. School boards and policy makers are trying to embrace an ethos for new progressive forms of practice which the public schools have never experienced before.

The reform ethos may also affect teachers' beliefs and attitudes. Such an ethos makes teachers aware that they have to put more effort into what they routinely do in their classrooms. It could encourage teachers to shift their attitudes or beliefs from the expectation of "just following" the routine to a commitment to the national movement, pursuing the question of how to teach in better ways. School teachers who believe in Open Education as a matter of building an organization of their classroom lesson which is substantially different from their familiar ways of organizing lessons know well that management of such a different organization will require a lot of work from themselves.

Reform-minded teachers are willing to embrace the ideal of authentic pedagogy, on the one hand, and, on the other hand, they take their routine classroom practice for granted as unavoidable. The ideal provides an orientation for beliefs and attitudes wherein teachers set goals for better lesson practices, but at the same time those goals can seem as never quite realizable. We cannot deny that there could be a gap between what teachers believe they could do better and what they actually do. This study is not to criticize teachers' beliefs or attitudes about authentic pedagogy. Rather, this study takes as problematic the question of why it is so difficult to "routinize" the ideal of authentic pedagogy. Why does it require much greater effort? Why is it so difficult for teachers to turn such beliefs into a 'new' routine? What are the boundaries within which people consider issues of change and continuity regarding classroom practices, in confronting calls for instructional reform?

In order to pursue these questions, this study began its examination by giving
attention to the authentic pedagogy discourse that proposes Open Education, a classroom practice which researchers and teachers identify with several reformed features. One of the crucial concerns in the implementation of Open Education is often how to organize classroom lessons with reference to the multiple facets of the setting, e.g., diverse students, learning styles, and the organization of the curriculum. In these concerns, however, formal features of classroom organization seem to be treated as evidence of what the participants in the setting actually do. Questions related to the formal organization of lessons are concerned with how such objective features constrain and structure members' course of action. However, Open Education, as its advocates have argued, also manifests itself at the level of teachers' ideas, ideals or attitudes. According to such a perspective, even if the settings, in their organizational shape, appeared to satisfy objectively characterized criteria, but failed in realizing the ideal, the settings could not be said to implement Open Education appropriately. Here, the main indicators have to do with, for example, how the locus of power has moved between the two parties of teacher and student, or how classroom members make use of time and space.

Such an idealized image of Open Education unavoidably becomes an aspect of planning, members’ beliefs, or theoretical formulations, and reform-minded teachers and researchers identify the reform movement in such loci. If it appears that the ethos for change has waned and reform outcomes have been vague, the very existence of the ideal would be treated as a reason for why this is so; reform tends to be an ideal typical discourse. These characteristics of Open Education are observable in the public discourse, in that they provide reformers and policy makers with an orientation concerning what classroom reform and authentic pedagogy should be like. In the Korean case, Open Education has also been infused with a coherently recurrent reform repertoire, from the progressivism of its early days to the recent discussions of constructivism. In the development of such discussions, theoretical assumptions and arguments about the construction of meaning, order, and knowledge slip into repertoires of policy reform.
1. The social construction of the routine classroom lesson

Instead of constructing a new theoretical model for classroom lessons or examining their formal features, this study specifies a praxiological logic for understanding the everyday practice in the classroom lesson. What this study asks concerning the routine classroom lesson is not so much about its objective organizational features, but about the social-discursive organizations wherein the teacher and the students construct the meaning of the curriculum, as they pursue its practical enactment.

With such a concern, this study has identified two different aspects of the routine classroom lesson in the science classrooms I observed — questions with known answers, and instructing and enacting demonstrations. These two activities are characteristic of the social organization of normal classroom science practice, and I was able to identify this social organization, relying partly on the findings in the studies of conversational and classroom interaction, and partly on explanations of the nature of scientific work that have been suggested in social studies of science.

First, this study attended to the basic order of classroom lessons that has been explicated in the study of classroom interactions in instructional sequences — the common sequence of teacher's question and student's answer unfolded in the social organization of the IRE sequence (Initiation-Reply-Evaluation). Then it identified the most noticeable discursive features of this questioning practice, and demonstrated how this basic organization was recurrent across the observed settings, and rendered the classroom lesson stable and familiar for teacher and student alike.

This study has observed that the persistence of the IRE sequence is closely related with the first organization of cohort-based lessons. In the normal classroom lesson culture, the two-party structure — teacher and student — is the first order wherein the participants experience the meaning of the implemented curriculum. The routine exercise of questions with known answers is constructed in a way that establishes the participants in the setting as teacher and student, and the social identities of teacher and student is an ongoing accomplishment of the participants' activity.
Even though the enactment of the IRE as the cohorting practice of the classroom shows the social constraints of the school institution in that way, given the organizational context of cohort-based education, it seems an unavoidable lesson method in the classroom. Teachers routinely make use of the questioning exercise in order to check what the cohort knows and what they need to be taught. This is necessary for the teachers, who have to deliver their lessons to a party of multiple persons. It permits teachers to implement the lesson without separately performing such tasks as checking the cohort and enacting the lesson, as their enactment of the entire procedure remains embedded in the basic order of the IRE sequence.

As a formal feature of the two-party structure of the classroom, teacher-centered control of the cohort may convey an authoritative image. For the teachers already know the answers to the questions they pose, and this provides the teachers with a resource for control of the content which the students will experience in the questioning sequence. Nonetheless, the routine features of the cohort-based instruction through IREs are both constitutive parts of the lessons and outcomes of the joint construction of the classroom lessons, where the actual course of questioning and answering is determined in interactional circumstances.

This can be observed in the role of the third turn evaluation in the IREs. The IRE sequence has been taken as a recitation model, owing to the fact that the teachers enact their lessons through posing questions and assessing the adequacy of answers. In this organization, the pursuit of the answer to a question in the sequence will be resolved when the exchange of question and answer gets to the third turn evaluation. However, as observed, the third turn evaluation does not simply constitute a privilege for the teachers in the implementation of their lessons. For even when the teachers arrive at the third turn evaluation, they still have the task of getting the students to identify and understand what evaluation intends to teach. And they can do so, making use of questioning practices, because the adequacy of question and answer is interactionally produced, through a process of informing and being informed by the students. While the teachers and the students are engaged in the interactional order, their practices are still enacting the IRE
exercise, and how they do so are among the routine practical tasks, and constraints of the lesson.

The persistence of the IRE sequence is also observed in the higher-order questioning strategy that is designed to elicit higher-order responses (such as a reasoning or generalization) from the students. Such strategies are often proposed as an alternative to the IRE exercise. Whether they can achieve the purpose of eliciting a higher-reasoning response is a practical matter. That is, they might do so or they might not. Nonetheless, even when the teacher and the students are involved in the higher-order questioning exercise, they do so within the basic order of the IRE sequence, without time-out.

Taking the social organization of the IREs into practice, a main concern for the teacher is a procedural, practical matter, e.g., when the known answer should be revealed or should not, by whom it should be revealed or not, how to make question and answer together available to the cohort of students by making use of the order of interaction. The teacher and students act in terms of their expectations about what has happened, is happening, and may happen. Such expectations are accomplishments based on their sense of the procedure wherein teachers enact the lesson. Along with such an expectation, the students learn what the lesson shows. Expectations permeate and are shaped in activities while they change in the course of activity, which may go backward or forward. These are embodied in the social organization of the IREs. The social organization of the IREs is durable, and it works as one of the routines of the everyday classroom lesson that renders it familiar. If teachers had to wait for their students to raise questions, or to discover a problem for the inquiry to follow, lessons would be difficult to complete.

Demonstrations by the teacher also recurrently take place in classroom science lessons. Teachers discursively shape the field of phenomena in which the students can find out how to see, hear and speak in the way that the demonstration shows. In particular, a discursively managed demonstration by the teacher provides primary sources for the students to conduct their own inquiries. The demonstration is not a demonstration of inquiry in which students watch and await unexpected outcomes, but a demonstration
of lessons in which its interactional production constitutes the central condition for efficacious, orderly actions, and deeply shapes what participants see, talk about, hear, and thus what they do next.

The concerns in instructing a demonstration have to do with a procedural matter of how to manage the demonstration in order to shape and secure what the teacher wants to instruct, within the developing situation. Discursively built lessons, rather than abstract, formal instruction, irremediably constitutes the setting of the classroom lesson which envelops the students and leads them to experience the curriculum. What is demonstrated by the teacher is not experiment or pure reasoning to arrive at discovery, or an inquiry based on principles, but a demonstration of instructions which the students can identify and re-enact.

Even though instruction is given, and the outcome of the demonstration has already been presented to the students, once the students are engaged in enacting their own demonstration, they find what the lesson promises in the course of performing the demonstration. For, by nature, the instruction which they are given by the teacher is indefinite. How the instruction is accomplished depends on the students’ following the enactment of the demonstration as a contingent practical matter. It does not seem that the students’ actions in following instructions take place in the form of a formal correspondence exercise. Rather, the students’ work on the demonstration takes the form of ordinary actions, which are shaped by the social constraints of the lesson time, the practical contingencies of tool use, and the contexts of interaction with fellow students. Nonetheless, when we look at these ordinary actions from a praxiological perspective, we can observe learning by doing, discovery learning, problem solving and collaboratively making sense of the procedure.

The routines of the IRE exercise and classroom science demonstration unfold in their own social organizations, which are built upon the teachers and students’ sense of the procedure they are engaged in, regardless of judgments about whether or not their practical knowledge and competence are authentic. Without them, we wonder how the teacher and students could implement and experience the curriculum in the classroom.
setting. Rather, the lesson is constructed as familiar tasks wherein teachers and students make use of practical knowledge, mundane daily activities, practical reasonings, vernacular talk and a sense of procedure. It may be owing to the nature of such a routine that teachers and students find the classroom familiar and stable, even when they implement new lesson programs. Such ordinariness comes from the familiarity of practical actions and practical reasoning with which the teacher and the students are involved in their everyday lessons. If so, it may be difficult to distinguish the routine classroom practice from the reformed practice.

The mundane classroom practices that are described in this study take place so recurrently that they appear to be structured, unfolding in similar patterns. These practices are shaped by and simultaneously shape the settings in which we find them, and are for the most part taken for granted by members. The practical actions and practical reasoning of what takes place in the classroom setting may be uninteresting for competent teachers, because they can enact their lesson without the need to be aware of themselves at every second. Competent teachers do not have to verbalize fully their accounts about routine classroom practice, and they do not face many problems in providing justifiable accounts to their colleagues, “because they have already been through most of the arguments about what should be done in the situations they face” (Douglas, 1970, p. 41).

We can argue that the durability of the routine classroom lesson characterized by questions with known answers and demonstrations is very close to the organization of the classroom lesson itself. Geertz (1973) claimed that “culture is not a power, something to which social events, behaviors, institutions, or processes can be causally attributed; it is a context, something within which they can be intelligibly -- that is, thickly-described” (1973, p. 14). The thickness of the local setting does not come from beyond-the situation-attributes but from the taken-for-granted structure of within-routine practices. Once the structure has been stabilized in the features of the setting, it tends to be concealed. The thickness of context is a durable framework for activity, with properties that transcend the experience of individuals. The matrix within which classroom actions are ordered works not as a map textualized in the head, but as the co-ordinates of the
situation, which are a product of the participants' activities and a condition upon which their activities are to unfold.

The autonomous realm of the mundane classroom setting seems to come from the nature of the everyday classroom practice. It consists of the tacit dimension of commonsense knowledge of the classroom lesson as non-problematic, taken for granted, mundane, conditions which are invariably achieved in teachers' and students' ongoing activities. Thus, local practices in classroom settings do not seem to be simply subordinated to the individual's psychological disposition or the policy formulations of the larger society. If everyday practices are powerful, it is because this is so.

2. Reconsideration of the authentic pedagogy discourse

This study began with a review of the contemporary reform discourses, especially in the Korean context. The field work has found organizations that appear to parallel several features of the reform discourse, e.g., teaching procedural knowledge, learning by doing, the "situated" use of knowledge, discovery learning, and the joint construction of meaning. The actual phenomena in the classroom lesson are so delicate that we hardly discern the reformed feature from the routine practice. In order to find a possible reason for this, we need to reconsider the authentic pedagogy discourse, in particular as it is tied to constructivism.

A constructivist understanding of the nature of knowing and learning has led to a discourse supporting a policy of instructional innovation, which appears distinctively and coherently in the "authentic" pedagogy discourse. In one sense, a primary concern of modern classroom pedagogy is that pedagogy has the task of reproducing the social world, including the world of adult or professional work. The authentic pedagogy discourse considers the professional culture as a model for everyday classroom practice, along with theoretical considerations of how order, meaning, or knowledge is constructed in the social world. Constructivist discussions have suggested a rationale for the ground
upon which teachers can design and instruct the curriculum. They have founded such a
ground in arguing the continuities between work practices in the world, and in the
classroom. Such similarities provide insight for the formulation of pedagogical principles
of how children should be encouraged to learn and to prepare for the social world.

Constructivism is not new in educational studies, but it has shown progress in various
scholarly endeavors over the century. Once such endeavors are tied to reform discourse,
they turn up as a familiar and similar reform repertoire, and the Korean case of Open
Education is not an exception. The familiar discourse is observable in "inquiry learning,"
"learning by doing," or "self-directed learning." These phrases remain an essential part of
the repertoire of constructivist educational reform, whenever it is advocated.

For example, the idea of learning by doing or discovery learning in science education
involves the effort to create a situation in which to teach the students the "real" shape of
scientific work. This phrase has been a maxim for 40 years. Such a claim is so recurrent
that it is not difficult to find its place in the history of the instructional innovation in
Korea. Its effectiveness as a "repertoire at hand" for formulating change in the everyday
culture of the classroom is apparent. On the other hand, the fact that it appears over and
over may reflect how difficult the realization of the claim's intent might be.

First of all, for the teacher and students alike, teaching and enacting a classroom
science project is a far more practical matter. To a great extent, the classroom science
project consists of "craft" skills: e.g., the use of apparatus, the motor skills involved in
elementary laboratory tasks, the familiarity with units of measurement, and so forth.
Teachers struggling to follow their beliefs to fulfill the purpose of the reform seem to
have little alternative but to do so from within these routines as well. The students form
their activities as a response to immediate and contingencies. The settings are made as
they are overwhelming by contingencies. The ordinariness of lesson practices seems to
arise from the fact that the teacher must respond to the situated constraints, including the
immediate needs arising from the setting. The question of how to settle on a new form of
the classroom lesson has to do with how to un-do the routine of the classroom lesson, and
how to respond to the immediate needs of the setting differently than how we routinely
That teachers' and students' work in the classroom consists of practical actions and practical reasoning does not necessarily imply that these can be treated as a unified conceptual engine for understanding students' learning. Claims to teach the use of practical knowledge tend to treat social context or practical knowing as a "conceptual space." They tend to treat contextual knowledge as a conceptual framework, for understanding knowledge structure, or the acquisition of tacit knowledge. In this way, they tend to set up a rationalistic model for authentic inquiry learning.

Instead, teachers' lessons have to do with making the curriculum publicly available to the students. This constitutes a context of inquiry which is reflexively tied to the students' activity. This is far from the image of inquiry which describes the motivation of the students as arising from intellectual curiosity and the desire to solve the problem. The course of students' activities finds the purpose at hand in an ad hoc way, rather than being directed by an external goal. Thus, immediate needs from setting-specified circumstances work as motivation for classroom lesson practices. The immediate needs appear to be interwoven with expectations of what is to take place in the setting. Thus, motivation is neither merely internal to the students nor to be found only in the circumstances.

The classroom as a setting of actions is a concrete condition and also an achieved feature of practices in which the contingencies in the setting are produced and ordered. The classroom participants are engaged in the ongoing activity far more often than they are paralyzed in suspended action, and they determine their next courses of action every second. Such an occasioned organization seems unavoidable, and it cannot possibly be reduced to a unified method with which the classroom lesson might be conducted in diverse settings. Such an occasioned feature works not so much as a residual of the lesson contents, but the ground upon which the routine classroom lesson is constituted, e.g., the contextual organization of classroom practice as a durable condition of it.31

---

31 Macbeth (2000) finds the properties of classroom teaching as the work of an "installation" in classroom settings. He illustrates how local ways of building "knowledge-in-place" shape
This study makes problematic how we can tell the difference between the routine organization of classroom practices and the features that the authentic discourse has proposed in some sense. Classroom science cannot be the same enterprise which the professional community of science practice builds. Nonetheless, this does not necessarily mean the classroom science lessons observed in this study are not valued as the subject matter of the school science curriculum. Rather, classroom science provides good resources for curricular activities among early-grade-level children. There seems to be no way in which the curricular exercise could be an "authentic" version, not because it has no authenticity, but because the characterization is an idealized image of everyday practice, either for lay persons or for professionals.

For example, the success of a demonstration in the science classroom depends not on discovery or testing of a hypothesis but on a faithful reproduction of a course of action (Amerine & Bilmes, 1988; Delamont, Beynon & Atkinson, 1988). Demonstrations in school lab do not test the validity of a scientific hypothesis, but the competence of the teacher and students in enacting it. Collins (1988) points out that classroom science is a typical case of a 'stage managed' demonstration which is designed to convey past discovery to the public in a public space. Thus, in demonstrations, "the history of science is eradicated, so the particular is seen as the general" (Collins, 1988, p. 728). This does mean not that school science is not pedagogical, but that the culture of school science is really different from an image of the apprenticeship of novice scientists (Atkinson & Delamont, 1977; Cobb, Wood, & Yackel, 1991; Delamont, Beynon, & Atkinson, 1988).

In sum, while the authentic pedagogy discourse pursues a theoretical concern, it tends to "overintellectualize" everyday practices in the classroom lesson. In general, this seems to be due to its "theorizing" the mundane practice in the social world. Constructivism has developed a strong argument against foundationalism, and has much to teach us about curricular exercise in the early grades. Borrowing from Gibson's (1979) formulation of "affordance," he pursues the question of how the classroom affords concrete tasks to be learned, as is a "material surround of knowing's objects and competency's projects" (p. 24).
classroom pedagogy. Everyday classroom practice contains, as social constructivists have claimed, no script which guides the participants to do what they do. The participants immediately find their way to the next actions, and in this way they are engaged in the procedure of constructing meaning, order, and knowledge in the setting. However, that they construct order, meaning and knowledge is far from saying that they have arbitrarily constructed it, or that there are political implications for the social legitimacy of the classroom structure. Instead, once constructivist claims are accepted, the argument against foundationalism sometimes seems to be forgotten. If we accept the principle that the social world is socially constructed, then we may recover the ways in which it is routinely grounded.

In classrooms, what we can find is the constructive order of the routine grounds of everyday classroom practices. Taking such an aspect into consideration, we can see that what is neglected in much of the reform discourse is the very existence of the practical contingencies of common understandings which actually build the course of action for both the teacher and students at lesson time. In other words, theoretical understandings of social practice tied to the educational reform discourse tend to exclude the practical contingencies involved in the flow of the classroom lesson and the participants’ sense of them. This is partly owing to their assumption about collective cognition and a theoretical treatment of the social nature of knowing as an engine for it. However, such contingencies are reflexive to the first order of the setting for the teacher and students alike. It is in the participants’ dealing with the practical contingencies of the interactional order that they achieve a common understanding of the classroom lesson.

The contextual details as the first order of the setting are, as Lynch (1993) observes, "practically objective" in situ, for the teacher and the students who are engaged in the lesson. They are routinely involved in the order of lessons, without any doubt. The disposition of their action seems natural and naive — “the natural attitude,” as phenomenalists have termed it. Nonetheless, it is not so naive nor conditionally responsive. Rather, it is a disciplined disposition and culturally appropriated “habitus,” as Bourdieu (1990) termed it, meaning that it represents “embodied history, internalized
as a second nature and so forgotten as history" (p. 56). It guarantees “the ‘correctness’ of practices and their constancy over time, more reliably than all formal rules and explicit norms” (Bourdieu, 1990, p. 54). This should be taken into consideration when we discuss the issue of the next instructional innovation.

3. Conclusion

In conclusion, the ambiguity between reformed practices and the existing practices that are brought into view owing to the persistence of the routine practices as this study has observed, may not be exceptional for the Korean case. Although the ethos for Open Education seem to have already faded (in 2001), nonetheless, reform persists. The name of Open Education has gone, but instructional reform policy is still alive. This comes partly from the fact that the problem for researchers and educators is not just whether the outcomes of reform are successful or not, but that it is difficult to tell success from failure. Thus, once the ethos for educational reform has waned, the critiques of reform arise. Critiques of reform identify various facets as responsible for its failure. Among the possible reasons, this study finds one in the taken-for-granted routine grounds of the everyday classroom lesson.

As a matter of fact, the failure of reform seems to be predictable in some sense, insofar we can hardly tell whether reform succeeds or fails. One of the possible reasons of this is that the routine organizations of the lesson render the everyday settings familiar and stable, and thus it is difficult for one to tell the outcomes of reform. Academic discourse for authentic pedagogy, when it meets with the reform repertoire, tends to become a resource for strong policy, but policy alone cannot leverage reform.

The authentic pedagogy discourse seems to be a poor resource for the teachers of students at early grade levels to follow. It seldom takes such routines and the social organization of practical actions which build them as the public event of lessons into consideration. The difficulty of changing the classroom lesson culture seems too
enduring to attribute its cause to teacher’s incompetence or to an out-of-date repertoire of routine practices. Rather, the socially organized local culture of the classroom seems to be capable of resisting any extraneously imported practice. From this perspective, it seems meaningful to perform an investigation of the mundane settings of classroom lessons as well as the question of how to transform them.

This study has conducted a close examination of selected cases of classroom science lessons. I have discussed the examination of the details of the scenes in relation to the reform discourses, and tried to find answers to the research questions this study has posed. There could be a criticism of the examination in that it demonstrates only partial evidence regarding an explanation of the problematic of reform, owing to the limited number of observed scenes. Nonetheless, inasmuch as scenes similar to these take place over and over across the settings of the science classroom, the discussions in this examination point to an essential question that remains, and will recur, with the next iteration of instructional reform.

The implication of this study for school teachers in implementing better teaching may be indirect. The study pursues an analytic interest in how we can examine instructional reform and classroom lessons. Its primary address is to the research literature, rather than the professional literature. The implications of this study are for the research community in educational studies, which is responsible for producing the research-based discourse of instructional reform. How the outcomes of this study hold implications for school teachers to examine for the improvement of their lessons, remains as a further task in the future.


Aronowitz, S., & Giroux, H. (1987). Ideologies about schooling — Rethinking the nature of educational reform, Curriculum Inquiry, 7 (1); 7-38.


Delamont, S., Beynon, J., & Atkinson, P. (1988). In the beginning was the Bunsen — The foundations of secondary school science, *Qualitative Studies in Education*, 1 (4); 315-328.


232


Erickson, F. (1986). Qualitative methods in research on teaching. In M.C. Wittrock (Ed.).


Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories — Beliefs about knowledge and knowing and their relation to learning. Review of Educational Research. 67 (1); 88-140.


Center for science and mathematics education.


