Science teachers play a pivotal role in mediating social and academic language in the science classroom through teacher talk and management of classroom discourse. In multilingual science classrooms understanding how native and international languages (English) are used to support meaningful science learning is essential for improving the quality of student learning. Consequently, the purpose of this study is to investigate student and teacher multilingual language practices that potentially influence conceptual understanding in middle school science and examine their meaning-making of such language practices.

Data came from middle school science classrooms within different SES. Teachers in these classrooms were interviewed and at least eight of their lessons were videotaped followed by video-based student focus group interviews. A multi-level dialogic framework was used to analyze language practices and participants’ meaning-making. Classroom interactions are analyzed based on communicative approaches (authoritarian/dialogic) and patterns of discourse. At the micro level, we analyzed utterances based on science knowledge types. We also analyzed shifts among native and international languages. It was found that within lower SES contexts, teachers use native language for connecting phrases with the insertion of English technical terms. Another language practice involved preparing students for the language demands of the national tests given in English. Teachers and students’ meaning making of their language practices involved both ideological and instrumental aspects, for example from a macro perspective, a theme emerged on how schooling influences reproduction and resistance of social narratives.

Keywords: Science Classroom Interactions, Multilingualism, Conceptual Understanding

SCIENCE IN MULTILINGUAL CONTEXTS

Quality science education is especially challenging in complex multilingual societies such as the case of several countries in the Middle East and North Africa (MENA), where issues around language, identity and globalization intersect with science education. MENA region students have not been performing well in science in assessments such as PISA and TIMSS; therefore, there is a need to enhance the quality of science education and to explore challenges and opportunities in such multilingual settings. Language is a basic aspect of culture and society, and a mean to doing science and developing science understandings (Yore, Bisanz, & Hand, 2003). Thus, language-in-education policies impact the development of cultural identities and the quality of science learning. Moreover, proficiency in global languages such as English develops fluency in science/technology discourses. In the country where the study was conducted, science is taught in a foreign language based on a policy that dates to the early 20th century. Consequently, the research questions guiding the study are: 1) What are existing language practices that teachers engage in to support understanding?, 2) How is the native language used in the science classroom and for what purposes?, and 3) What are teachers and students’ perceptions regarding teaching science in a global language?

From a sociocultural perspective, classroom discourse is seen as shaping the social life of classrooms, with the teacher playing a central role as mediator of social and academic language (Mortimer & Scott, 2003). In multilingual societies, ways in which native and global languages are used are especially important for supporting meaningful learning and students constructing meaning of science. We conceptualize mandated language-in-education policies set by institutions of power as “authoritarian discourse” as they determine language of instruction and testing (Bakhtin, 1981, 1986), while local language practices and ways participants’ give meanings to authoritarian discourse are seen as internally persuasive discourses that
manifest themselves in classroom interactions and speech genres. Most science classroom interaction and speech genres studies, however, were mostly conducted in mono-lingual contexts or with language minorities rather than multilingual societies. There is very little research that investigates science classroom interactions in contexts where English is the language of science instruction and the spoken language is colloquial Arabic.

**METHODOLOGY**

Naturalistic case studies were conducted with four middle school science teachers to help us understand complex phenomena that can be different in different classrooms (Stake, 1995). Grades 7 and 8 chemistry and biology classrooms were observed and video-taped in two public and two private urban and rural schools. The private schools served lower middle class students, where language issues are more prominent. The medium of instruction of science is English while the spoken language is colloquial Arabic. Data sources included: (a) classroom observations and eight videotaped science lessons, (b) semi-structured interviews with teachers, and (c) students’ focus group interviews. To analyse classroom interactions, a multi-level framework for analysing speech genres was adapted from Mortimer and Scott (2003). We revised the framework to highlight language shifts within a multilingual setting. The framework is based on five linked aspects of classroom and teacher talk (Table 1).

Table 1. Linked Aspects of Classroom and Teacher Talk

<table>
<thead>
<tr>
<th>Aspects of Classroom Talk</th>
<th>1. Teaching purpose</th>
<th>2. Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Focus</td>
<td>3. Communicative approach</td>
<td></td>
</tr>
<tr>
<td>ii. Approach</td>
<td>4. Patterns of discourse</td>
<td></td>
</tr>
<tr>
<td>iii. Action</td>
<td>5. Teacher interventions</td>
<td></td>
</tr>
</tbody>
</table>

Content, Patterns of Discourse, and Teacher Interventions were re-defined to examine and discern qualities and patterns in science classroom interactions along with language variations. Within content and to focus on development of conceptual understanding in science, we analysed utterances based on science knowledge types: Factual, Conceptual, Procedural: Inquiry or Algorithmic, and Metacognitive (Anderson & Krathwohl, 2001). A prevalent discourse pattern in science classrooms is the IRF pattern: Initiation, Response, and Follow-up (Lemke, 2001). Codes were added to discern language practices and shifts in use of a first and international language in knowledge types and IRF (e.g., I_A: Integrated Arabic utterances & I_E: All English utterances). We also re-defined ‘Teacher Intervention’ as a normative concept to discern strategies used by teachers to address language and conceptual issues, or ones they could have used. We also highlighted whether language variations were associated with variations in communicative approach: Interactive/Dialogic, Non-interactive/Dialogic, Interactive/ Authoritarian, Non-interactive/Authoritarian.

**RESULTS**

Language practices and supports for science understandings

The following trends emerged in the private schools: 1) teachers’ almost exclusive use of English to explain; 2) most students used spoken Arabic to explain themselves and ask for clarifications with English used to give short factual responses; 3) teachers’ adamant use of English continued even when students exhibited difficulties; 4) lively conversations ensued when teachers used Arabic and connected to students’ life; and 5) factual and procedural algorithmic utterances dominated. The following emerged in public schools: 1) teachers used colloquial Arabic to different extents in explanation; 2) students mostly answered with short

---

1 Arabic is diglossic in nature
English utterances; 3) feedback and elaboration statements included more English as a closure to discussions; 4) there was dominance of factual content but teachers’ utterances included more conceptual initiation questions to which students responded in spoken Arabic to explain their reasoning.

Participants’ perceptions of language issues

The following trends emerged: 1) teachers have had minimal purposeful preparation in addressing needs of students’ with limited English proficiency; 2) students’ language proficiency was a concern to teachers due to its impact on performance on national exams which are in English; and 3) teachers got mixed messages on how to deal with English proficiency levels and ways to use Arabic. Students’ saw the utility of learning English for future studies and business. None expressed that the policy itself is problematic but rather its implementation, where they expressed a strong preference for classroom communication in Arabic.

DISCUSSION AND CONCLUSION

Consistent with literature, the prevalent discourse pattern observed were variations of IRF and IRF chains, and the communicative approach observed across all contexts was authoritarian/interactive. Yet, teachers’ language practices across contexts did vary. The private school teachers did not seem to see Arabic as a facilitating language for understanding science, with limited attempts to bridge English/Arabic/Science discourse. Their adamant use of English may have been binding considering students’ limited English proficiency, and may have hindered deeper conceptual learning. Language-in-Education policy as authoritarian discourse emerged stronger in private schools (Bakhtin, 1986), which can be due to prestige that private schools like to maintain. The teachers’ themselves engaged in internally persuasive dialogue on how exclusive use of English may be ‘less confusing’ to their students. Most students, on the other hand, did not see English as a ‘communication’ language to understand and make-meaning of science concepts. In the focus groups they acknowledged an ‘instrumental’ importance of English and science English terminology, especially for further study and work. However, consistent with classroom observations, they were more comfortable expressing themselves in spoken Arabic. While we observed some teacher strategies that supported students’ language needs and conceptual learning of science content; more purposeful and systematic training and follow-up is needed to build on and develop conducive practices that further enhance students’ meaningful learning in science. A form of ‘Intersectionality’ emerged between teaching practices that disadvantage students with lower English proficiency and lack of ‘simply good’ teaching practices in science education.

REFERENCES


