Levels of Inquiry: Role of Language & Assessment

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Purpose of the Study

This paper-presentation is based on my observations and analysis of my students and my discourses and inscriptions as I engaged them in the process of learning how to teach science at the elementary grade levels.

Introduction & Significance

Science education reform efforts around the world are focusing on teaching and assessing science learning with emphasis on inquiry where the learners construct their own knowledge (Bruner 1960, Driver 1983, Glasersfeld 1998, Lemke 1990, NCERT, 2000; NRC 1996). This concept of knowledge construction, often called constructivism, has revolutionized teaching and learning of mathematics and science. Glasersfeld (1992) emphasizes that the foundation of any learning process is language and the meaning different people assign to objects, events, and experiences. Mental abstractions of sensory materials construct concepts. Bloom (2001) further explains how this process of inquiry and knowledge construction is language dependent. Discourses that happen in a science classroom are distinctly apart from day-to-day life discourses and may even be categorized as a discourse in a "new" language – the language of science (Lemke, 1990). Language of science is like an "Auntie-Tongue" – the language of the elite (Dasgupta, 1993). These discourses influence the inscriptions (written descriptions) of both the learner (student) and the learned (teacher). Ultimately, these discourses and inscriptions establish the assessment and evaluation practices and their results. By recording and analyzing the above described experiences, we are able to shed more light on the complex process of learning and teaching and hopefully be able to help ourselves and others in becoming better learners and teachers of science.

Research Approach

Data Collection: For the past twenty years I have worked with students from primary to college level at various schools and colleges in India and United States of America. The data that forms the basis of this paper is based on selected samples of these students' work and some of the discourses I have had with these students either individually or in a classroom setting. I did not begin this study with any particular purposeful question to investigate. I was simply teaching and attempting to become a better learner and teacher of science and help my students become better learners and teachers of science. In research literature, such studies are categorized as phenomenological studies.

Philosophical Basis: Phenomenology does not provide a prescription for conducting research but presents a script after the play is played and the curtains are drawn. This script explains the process that was involved in arriving at the conclusions and the suggested implications. (Berger & Luckmann, 1966; Bogdan & Taylor, 1975; Lincoln & Guba, 1985; Maanen, 1988). I, the researcher, was the key instrument of data collection. Using myself as an instrument enabled me to be responsive, consider the circumstances, adapt techniques to the situation, analyze the data instantly, and clarify and synthesize as the study evolved (Lincoln & Guba, 1985).

Data Analysis: Data analysis was conducted simultaneously with the data collection phase. I highlighted specific aspects of my classroom discourses and asked my students to do the same regarding their inscriptions. This was followed by categorizing the data following open coding, i.e., each phenomenon was given a name and generally the names were "in-vivo", that is, words from the data itself were used to label or code the data (Strauss & Corbin, 1990, p. 69). These codes were synthesized to form "main-codes" followed by further synthesis into "meta-codes". A report was compiled for each of the "meta-codes". Based on this report I was able to arrive at various themes that included the "main" as well as the "open" codes. From time to time, I have shared my analysis with my students for member-check (Lincoln 1985) and they have helped me further evolve and refine these themes.

Discussion

Based on the data analysis the following themes were obvious:

Science learning and teaching happens at different levels of inquiry depending on who is constructing what

knowledge and how it is being constructed. For example, who poses the questions/problems, who is responsible for devising the procedures, who is finding the solutions or who is replicating what is already known (Bonnstetter, 1998).

Language plays a critical role in this process of knowledge construction. For example, often when asked to "explain" (infer) a phenomenon, my students will "describe" the phenomenon and vice-versa. Similarly, "objects float because they are light" is often expressed because that is what is commonly believed and unfortunately written in many textbooks, including the ones my students use.

The native speakers of English have no particular advantage over non-native speakers in the process of learning science using the English language. Even for the native speakers the language of science is a "new" language often perceived as a foreign language and/or the language of the "elite".

Ultimately, the level of inquiry and language determines the nature of assessment and evaluation practices.

During my presentation, I will show several examples of the raw-data, followed by how the data was analyzed and the reports complied followed by how I arrived at the above conclusions.

Implications

Constructing scientific knowledge in an inquiry-based instructional setting is absolutely dependent on language skills and processes irrespective of the language of instruction. Even for people who speak just one language and are instructed in that language, the process of inquiry and knowledge construction in science is experienced as a "new" language acquisition. This does not mean that we teach science as a language acquisition process but guide the learner to evolve and explain their ideas and connect those to language and math instruction they are receiving. This demands that the science, math and language curricula be aligned both horizontally and vertically.

To facilitate construction of knowledge the learner has to be provided with the opportunity to construct and communicate that knowledge at different levels of inquiry and this process should make connections between the learners', peers', teachers' and the scientific language.

There is a need for the learned and the learners to comprehend the complexity of the discourse that happens in science classrooms to enable instructive feedback loops. The ultimate aim being the establishment of demanding and yet successful science learning and assessment experiences for ALL learners.

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