



<http://www.diva-portal.org>

Preprint

This is the submitted version of a paper presented at *European Conference on Educational Research (ECER), University of Porto, September 1- 5, 2014.*

Citation for the original published paper:

Bergvall, I., Wiksten Folkeryd, J., Liberg, C. (2014)

Language register in different domains of mathematics, and its importance for different groups of 8th grade students..

In:

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-234570>

Language register in different domains of mathematics, and its importance for different groups of 8th grade students.

Ida Bergvall, Doctoral student, Department of Education, Uppsala University
ida.bergvall@edu.uu.se

Jenny Wiksten Folkeryd, Senior lecturer, Department of Education, Uppsala University
jenny.folkeryd@edu.uu.se

Caroline Liberg Professor, Department of Education, Uppsala University
caroline.liberg@edu.uu.se

First and second choice network:

1. Mathematics Education Research
2. Language and Education Network

Key words: Language of mathematics, Discourses of mathematics, Student performance, Mathematics education, Large scale testing

General description

The development of a language repertoire in school mathematics is dependent on opportunities to participate within functional settings where explicit focus on how different linguistic choices in mathematics can give different meaning to the text (Morgan, 2002). It is therefore of importance to find out more precisely what language dimensions that characterize school mathematics, and if these differ between domains within mathematics. Secondly it is important to identify if there are language dimensions that will be a hindrance or a scaffold for different groups of students.

The study presented in this paper is part of a larger study of the academic language of school mathematics, and its significance for students' reading of mathematical items in order to solve them. Three sub-studies will analyze various aspects of the academic language in school mathematics such as linguistic features, visualizations and mathematical symbols. In this first sub-study linguistic features will be in focus concerning mathematical items in the international study *The Trends in International Mathematics and Science Study* (TIMSS). Much research done concerning linguistic features has focused the language of mathematics as a whole, and not looked at different domains within mathematics. Here the mathematical domains algebra, data and chance, geometry, and number, will be focused. Using a large scale study like TIMSS, it is possible to investigate the significance of language in a systematic manner for different domains within mathematics, and also for different groups of students. The study aims to

- identify characteristic linguistic features in mathematical items such as those in TIMSS
- examine which, and to what extent, linguistic features influence the results in TIMSS 2011 for different groups of Swedish 8th grade students.

Firstly the study is based on a social semiotic perspective as it is developed in systemic functional linguistics (SFL) (Halliday, 2004) in order to deal with the first aim. A text and its

features are seen as a realization of the context of situation, and thus reflecting the social order. In different social contexts, different registers of language are used. In SFL such registers are described as a configuration of what the text is about (field of discourse), personal relationships in the text (tenor of discourse), and how the text is structured (mode of discourse) (Halliday & Hasan, 1989). By using register as a base for the linguistic analysis the results will be more generally applicable for different languages. The register continuum for field of discourse spans from commonsense and everyday aspects to technical and specialized. The register tenor of discourses goes from personal and informal aspects to formal and objective. The mode continuum covers less complicated and unpacked language to more complicated and packed language.

Secondly a reception theoretical perspective (for a school context see e.g. Langer, 2011; Liberg et al, 2013; Luke & Freebody, 1999) is used to deal with the second aim. In such a perspective the text as such or the language of the text is not seen as inherently cognitive demanding. The cognitive demands are relative the encounter between the reader and the text within a specific context, i.e. no task can be called cognitively demanding out of context (Schleppegrell, 2004). Of importance are the reader's experiences and knowledge of the language used, the reader's pre-knowledge of and interest in the content of the text, and of reading such texts and participating in practices where such texts are read (e.g. Liberg, 2001). In this study the result performed by four different groups of students will be investigated, concerning language background and thereby presumed skills in the language of the test, as well as high or low performance on the test.

Method

The empirical data in this study consists of mathematical items and student's scores from TIMSS 2011 in grade eight. TIMSS 2011 contained 217 mathematics items (algebra: N=70, data and chance: N=43, geometry: N=43, and number: N=61). The number of student solutions available varies from 98 to 596 for each item and each of the four groups of students in focus of this study.

In order to analyze the language register of the four domains in mathematics a database with linguistic information on each item in TIMSS has been used (see <http://stp.lingfil.uu.se/timss/#Publications>). In this database each item is classified according to linguistic features such as the word class that each word belongs to, number of words per item, word length, and sentence length using *Extensible Markup Language* (XML) in a computer based automatic parsing. This kind of information is characteristic of different readability formulas. The use of a computer based parsing offers advantages by quickly analyzing a large material. A disadvantage is that the study is limited to the analytical potential the automated computer parsing provides. Linguistic features that indicate field of discourse is foregrounded in this analysis, but indicators of the tenor and mode of discourse will also be approached.

The dependent variables are composed by student test scores from four groups of students: students whose parents are both born abroad (henceforth: PBA-students) and students whose parents are both born in Sweden (henceforth: PBS-students), as well as low and high achieving students, i.e. the 25 percent with the lowest respectively highest performance in TIMSS 2011. To allow a comparison of results from items with different total scores the *percent right* or *p-value* on each item was used as the dependent variable. The p-value is the item average score divided by the maximum score of the particular item.

The analyses will be conducted in three steps. The first step concerns analyses in order to describe the register of each domain in terms of a constellation of linguistic features as indicators of the three discourses field, tenor, and mode. In the next step significant relations between the dependent variables and the independent variables are identified. This analysis is presented using a correlation matrix. A third step is planned to be a multiple regression analysis between the variables showing a correlation in the correlation matrix.

Preliminary results

Some preliminary results show that characteristic linguistic features of the register in algebra is that the field of discourse to a high extent is expressed by a precise language with many numerals and digits. In algebra, this particular feature also shows a significant positive correlation with achievement for PBA-students. One possible explanation might be that digits are used in different languages and in many countries, i.e. it is not language specific feature, and that mathematical items which relies on digits as important information carriers, provide second language learners opportunities to work with the mathematics without being hindered by a more demanding verbal language.

Salient linguistic features in the register of number and geometry show a different character than the domain of algebra and have, to a larger extent, a real life character realized through proper names and personal pronouns. Number and geometry has also more descriptive features in the form of adverbs and adjectives. The real life character of geometry shows a positive correlation with achievement and seems to give a scaffolding effect for all student groups studied even though these results are not significant for the low performing group.

The domain of data and chance is characterized by an information dense language realized by a high proportion of nouns. This feature does not show any correlation with the student's results. In the domain of number, on the other hand, there is a relatively low proportion of nouns but a correlation between this feature and student achievement can be seen. This correlation is significant for just PBS-students and high achievers. An interpretation of these results is that nouns in the number domain of mathematics give clarity in the way they express the content. This however, only seems to have a supportive effect for PBS-students and high achievers.

Intent of publication: NOMAD, Nordic Studies in Mathematics Education

References

- Halliday, Michael. A. K. & Hasan, Ruqaiya (1989). *Language, context, and text: aspects of language in a social-semiotic perspective*. 2. ed. Oxford: Oxford Univ. Press.
- Halliday, Michael. A. K. (2004). *An introduction to functional grammar*. 3. ed. London: Arnold.
- Langer, Judith A. (2011). *Envisioning knowledge: building literacy in the academic disciplines*. New York: Teachers College Press.
- Liberg, Caroline (2001). Svenska läromedelstexter i ett andraspråksperspektiv - möjligheter och begränsningar. I: Naucér, Kerstin (red.) *Symposium 2000 – Ett andraspråksperspektiv på lärande*. Nationellt centrum för sfi och svenska som andraspråk. Stockholm: Sigma Förlag. S. 108-128.
- Liberg, Caroline, af Geijerstam, Åsa, Wiksten Folkeryd, Jenny, Bremholm, Jesper, Halleson, Yvonne & Holtz, Britt-Maria. (2012). Textrörlighet - ett begrepp i rörelse.. I: Synnøve Matre och Atle Skaftun (red.), *Skriv! Les! 1. Paper presented at Skriv! Les! Nordisk forskerkonferanse om skrivning og lesing*. Trondheim: Akademika forlag. S. 65-81.
- Luke, Allan & Freebody, Peter (1999). Further notes on the Four Resources Model. *Reading online*. <http://www.readingonline.org/research/lukefreebody.html> [downloaded 2012-02-13].
- Morgan, Candia (2002). The linguistic construction of social identities in mathematical communities: A Critical Linguistic Approach to *Mathematical Text*. In Myrdene Andersson: *Educational Perspectives on Mathematics as Semiosis: From thinking to interpreting to knowing*. Ottawa: Legas.
- Schleppegrell, Mary J. (2004). *The language of schooling; a functional linguistics perspective*. London: Lawrence Erlbaum Associates.