STUDENTS´ MEANING MAKING OF WORDS IN SCIENCE

The language in science classrooms has specific characteristics related to the use of words, grammar, and semantic patterns that may be a particularly challenging issue for students meaning making of science phenomena. The aim of the presented project is to investigate language related issues in relation to meaning making of school science in multilingual settings. This is done through a multidisciplinary (science education and linguistics) and quantitative approach in Swedish secondary schools. The research question is “what kind of words are challenging for students with Swedish language background and students with other language backgrounds”. Meaning making of words was estimated through web-based vocabulary tests given to 232 students in grade 7-9. In addition, the students were asked about their first language and how long time they studied in Swedish school. This data made it possible to calculate potential significant differences between groups of students and categories of words. On a general level, significant differences were found between the performance of students with Swedish as mother tongue and those with other mother tongues and within the group that arrived in Sweden later than school start. When focusing word types, we found differences between the groups in relation to two categories: “general academic words” (e.g. cause and consist of) and “colloquial but content related words” (e.g. pass and branch). On the other hand, difficult word categories for all students were “academic and content-related words” (e.g. trait and process) and “academic and content-typical words” (e.g. occur and indicator). We argue that, especially regarding students with another mother tongue than the language of instruction, it is important to give attention to the words that are general academic words along with the common focus on content-specific words – the concepts.

Keywords: Meaning making of words; multidisciplinary approach; multilingual settings

BACKGROUND

Several scholars (e.g., Martin & Veel, 1998; Seah et al., 2014) have emphasized that language usage in school science contexts may be characterized by high lexical density, abstraction, and technicality. In addition, the language in science classrooms has, according to Lemke (1990) specific characteristics related to the use of words, grammar, and semantic patterns that may be a particularly challenging issue. At the word-level, following Nation (2013) language use in science can be grouped into three categories: (a) science-exclusive words; concepts (e.g. allopatric, exothermic reaction, and force), (b) words found both in science and elsewhere, but with different meanings; homonyms (e.g. adapt, cycle, and energy), and (c) general academic words (e.g. converted, proceeds, and originates). All types of words are important in meaning making of science to appropriate the semantic pattern of how science is communicated in classrooms. In other words, teachers must understand how language influences learning and develop strategies to enhance students’ successful appropriation of scientific language in the continuum between every-day and scientific registers and increase the students’ discursive awareness and mobility in relation to content and language (Authors, 2019; Schleppegrell, 2016). Furthermore, might a specific focus on words be beneficial in the students´ meaning making processes (Logan & Kieffer, 2021).

Starting with the triadic idea from Nation (2013) have Authors (2019) developed a more fine-grained categorization with two main parts with three subcategories each. These are a) content neutral words divided in 1) common words (e.g. talk); 2) unusual words (e.g. disappointment) and 3) general academic words (e.g. consider) and b) content related words divided in 4) homonyms (e.g. pressure); 5) content-typical words (e.g.
pollution) and 6) content-specific words (e.g. photosynthesis). Historically science education and classroom practice have been focusing the latter category - the concepts.

The aim of this project is to investigate language related issues in relation to meaning making of school science in multilingual settings. This is done through a multidisciplinary (science education and linguistics) and quantitative approach in Swedish secondary schools. The research question is: what kind of words are challenging for students with Swedish language background and students with other language backgrounds.

METODOLOGY

Starting out as a multi-disciplinary collaboration, between science educators and linguistics, meaning making of words was estimated through four different web-based vocabulary tests given to 232 students in grade 7-9. Each test had 15 words selected from the textbook that the students would study two weeks later. One sentence was chosen in which one word was made bold and the students were given four alternative suggestions as synonyms. The words belonged to five of the six categories mentioned above (common words was excluded) and academic/official dictionaries was used to categorize the words. Example of words in the textbooks that we chose were: 2) unusual words (e.g. contemplate); 3) general academic words (e.g. process); 4) homonyms (e.g. solution); 5) content-typical words (e.g. indicator) and 6) content-specific words (e.g. symbiosis). In addition, the students were asked about their first language and how long time they studied in Swedish school. This data made it possible to calculate potential significant differences between groups of students and categories of words.

FINDINGS

On a general level, significant differences were found between the performance (scoring 1-15 on the tests) of students with Swedish as mother tongue and those with other mother tongues (see Figure 1) and within the group that arrived in Sweden later than school start (see Figure 2).

![Figure 1](image1.png)

![Figure 2](image2.png)
When focusing different types of words, we first found a need to differentiate our previous model for interpretation of homonyms (group 4) into two subcategories, namely homonyms that were 4a) *colloquial but content related words* and 4b) *academic and content specific words*. This alteration was guided by both the empirical data and newly produced dictionaries differentiating colloquial and academic words.

We found significant differences towards two categories of words between students with Swedish as mother tongue and those with other mother tongues: 3) *general academic words* (e.g. cause and consist of) and 4a) *colloquial but content related words* (e.g. pass and branch). However, difficult word categories for all students were also two categories: *academic and content-related words* (e.g. trait and process) and *academic and content-typical words* (e.g. occur and indicator).

**DISCUSSION**

It is not surprising that students with another mother tongue that Swedish scored less on a general vocabulary test and that the result correlate to time that the student has learned Swedish. It has been shown before (c.f. Authors, 2019; Logan & Kieffer, 2021) but it indicates that the tests have some reliability.

The main contribution of this study is that it points towards types of words that are extra hard for the students to make meaning of. We argue that, with respect to students with another mother tongue than the language of instruction, it is especially important to give attention to the words that belong to the category *general academic words*. These general academic words are important in the science classroom since they are the “glue”, or connectors (Gibbons, 2003), between the concepts. In other words, a scientific explanation is incomprehensible without the connectors that bind concepts (Silseth, 2018). It is hard to make sense of the important concepts without words like consist of or because. Therefore, science teaching should emphasize these words along with the concepts.

**REFERENCES**


