On Human Language and Terminology Used for Teaching and Learning CS / Informatics

Ira Diethelm
Carl von Ossietzky University
Computer Science Education
Oldenburg, Germany
ira.diethelm@uni-oldenburg.de

Juliana Goschler
Carl von Ossietzky University
Institute of German Studies
Oldenburg, Germany
juliana.goschler@uni-oldenburg.de

ABSTRACT
Competent use of language and specifically classroom language are key factors for successful learning. Thus, being "fluent with information technology", "CS fluency and competency", 'computer literacy' or 'computational literacy' are terms for learning objectives of ICT, computer science or Informatics courses that refer to skills in CS as well as to competences in reading, writing, and speaking. However, up to now, the aspect of linguistic competence as one prerequisite as well as a teaching goal in Computer Science has been largely neglected. In this paper we would like to lay the ground for the problem area of language competence, including a precise terminology, for teaching and learning CS. Therefore we will evaluate the existing research on academic language in other areas in order start a meta-discourse on a 'CS classroom language'. Furthermore, we will identify possible research questions that should be investigated in the future.

Categories and Subject Descriptors
K.3.2 [Computers and Education]: Computer and Information Science Education—computer science education, literacy

General Terms
Theory

Keywords
Classroom language, meta-discourse, terminology

1. THE PROBLEM AREA
Successful learning and teaching, no matter the specific field, needs a specific use of language in the classroom. This includes the precise use of terminology as well as a highly developed abstract ('academic') language that enables communication about abstract things. This issue has been a topic in applied linguistics for some time (see for example [5, p. 113-114]), but the exploration of implications for school subjects other than languages has only just begun.

The subject CS, as well as any other subject in school, needs specific terms and linguistic constructions to communicate about topics of our science in class and also outside in everyday life. Therefore it is astonishing that many national and international curricula mention the linguistic requirements only marginally.

We take it as given that it is important to communicate in classrooms with spoken and written language in every subject. And therefore a discipline-specific language is needed. This language consists of terms that express a widely accepted conception of a certain subject matter in question, but also of certain grammatical structures ('constructions') in which these terms are used appropriately. Learning a subject with this intention then requires competence in the related terminology and appropriate use of it in context. It is necessary to have a conception of the central discipline-specific terms to be able to follow discourses in the discipline and to formulate arguments and problem descriptions with the use of this terminology in such a way that another literate person from that discipline understands the information in the intended way.

The "operational definition of computational thinking" of the CSTA lists the following supporting skills of computational thinking that are connected to language in class:

- "Formulating problems in a way that enables us to use a computer and other tools to help solve them."
- "The ability to communicate and work with others to achieve a common goal or solution"

As an example for curricula, the CSTA curriculum from 2003 [2] formulates the social demand of communicating about IT as follows: Students at grade 2 will

- "communicate about technology using developmentally appropriate and accurate terminology".

The new computing curriculum from the UK [3] does not refer to terminology or spoken language directly but lists a few competencies that require them: Students "understand and explain the quantitative dimensions of a problem", "describe how internet search engines find and store data", are "able to explain how [a procedure] works and how to test it", "explain how instructions are stored and executed within a computer system" and "explain how data of various types can be represented and manipulated in the form of binary digits including numbers, text, sounds and pictures".
These two curricula show that there is agreement on certain communicative skills, however, the linguistic prerequisites stay implicit. If we want to achieve goals like ‘computational thinking’ or ‘computer literacy’ it is necessary to pay much more attention to the usage of language in class.

So far, this is not the case, as our first analysis of the use of terminology in CS textbooks for secondary schools shows very clearly: The definitions of central terms like ‘algorithm’ vary a lot from the definitions you may find in scientific textbooks for students at university. Furthermore, the definitions that lecturers give when asked to define programming, modeling, coding and implementing, vary considerably, see [4]. Thus, it is obvious that thorough research on the descriptions and terms used in textbooks for secondary schools is needed. This kind of research should lead to recommendations for writing CS textbooks as well.

2. DEFINITIONS OF TERMS

Terms are words that represent a certain conception of a special subject matter in the disciplinary context. All terms and their usage together form the language of a disciplinary context. A technical term then connects a word with an object in a meaningful context in a certain discipline.

‘Terminology’ is the body of all terms relating to a particular discipline, e.g. electronic engineering. It also is used for the science of terms in general. Often the word ‘terminology’ is also used synonymously with ‘language’ in the context of discipline-specific language, although ‘language’ is more than a list of terms.

In our discipline, however, terms like ‘domain-specific language’ and ‘special language’ are already linked with different meanings than in other disciplines: In CS computer languages are understood as tools and research fields on them. They have been developed for special uses in particular application domains of CS and are used for communication of humans with machines or machines with machines. So the term ‘discipline-specific language’ can easily be misunderstood. In other disciplines like the natural sciences, economy or law, these terms refer to the language people use to talk and write about scientific topics.

The term ‘scientific language’ often refers to the discipline-specific language used by scientists of a certain discipline to be used to communicate research results and to teach at university.

A term that focuses on the spoken or written language for humans to communicate about CS in the context of teaching and learning CS as a subject in school could be ‘CS classroom language’. In our conception this kind of language then is a combination of the everyday language and scientific language to communicate about CS. Therefore it is not only the sum of all terms of the discipline (the ‘terminology’ in a narrow sense), but it also contains the usage of these terms in disciplinary contexts.

The term ‘classroom discourse’ refers to ‘all forms of discourse that take place in the classroom. It encompasses the linguistic as well as the nonlinguistic elements of discourse. The former includes the language used by the teacher and the learners, as well as teacher-learner and learner-learner interactions. The latter includes paralinguistic gestures, prosody, and silence - all of which are integral parts of the discourse. The linguistic and nonlinguistic elements constitute the observable dimension of classroom discourse.” [6, p. 261]

Classroom discourse thus also includes different types of interaction between teachers and students. “Traditional lessons” (see [1]) encourage teachers to dominate the interaction (and therefore the language and terminology used): "[...] traditional lessons refer to the using of a three-part sequence: teacher initiation, student response, and teacher evaluation or follow-up (IRE or IRF)". In non-traditional lessons, the sequence of talk in classrooms does not fit an IRE structure on account of a changed educational goal, see [1, p. 31]. Lemke [7] and others advise teachers to use a less controlling type of discourse to encourage student participation to the largest extent. It is an open question to what extend these types of classroom discourse occur in CS and what this entails for the explicit and implicit teaching of the use of an appropriate language and terminology.

3. OPEN QUESTIONS

Thus, with these definitions on language used in CS classes some main research questions arise for the subject computer science:

1. What terms are used to communicate about content, concepts and facts of CS in respect to certain topics and certain target groups of learners? What is the overall terminology for teaching CS and how can it be structured and taught?

2. How do CS teachers and their students use these terms when speaking and writing about a certain CS concept and how does their terminology and language differ?

3. What is a suitable set of terms and definitions for CS teaching for introducing and applying a certain concept in CS classes?

4. How can classroom discourses be structured to support CS learning?

These questions map four main aspects of language in class: The terms (1.), their usage (2.), recommendations for terms (3.) and recommendations for their usage (4.) and should be subject for further research.

4. REFERENCES


