

Personalized grammar teaching on a tablet in inclusion classrooms

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“Grammatical support tools allow people who have difficulties with their grammar to make their computing and writing much easier. Good grammatical support can benefit even those without any learning disability or who do not think of themselves as having any significant grammar troubles.”¹ Suitable for this goal, we present the personalized grammar teaching system IN-COMPASS for inclusion classrooms. The system can be accommodated to different age groups.

IN-COMPASS is a new surface system operating on top of the language-technology based core system COMPASS (cf. [1] for its most recent visualization). COMPASS is an acronym for COMbinatorial and PARaphrastic ASsembly of Sentence STRucture. In the core system COMPASS, the student constructs sentences by composing syntactic trees out of lexically anchored “treelets” via a graphical drag&drop user interface (“scaffolded writing” [2]). In COMPASS, an advanced user can explore all linguistic details in an interactive manner (*self-paced* and *explorative learning*). A natural-language generator computes all possible grammatically well-formed sentences entailed by the student-composed tree. It provides positive feedback if the student-composed tree belongs to the well-formed set, and negative feedback otherwise. Proposals are based on a comparison between the student-composed tree and its own trees (informative feedback on demand). As feedback discusses the use of grammar rules, elementary syntactic knowledge is presupposed at the learner’s side.

In the following, we first focus on the basic features for grammar teaching in the core system COMPASS. In turn, we outline which details remain hidden by IN-COMPASS unless the pupil in an inclusive learning situation asks for more information.

COMPASS provides intuitive graphical support for grammar teaching. For instance, running on a tablet, the student moves (parts of) trees around with the finger or a stylus, resp. Especially, word-ordering—which is a difficult topic for learners of German—is performed by the student as graphical dialog with the system, i.e. by moving branches into field positions provided by the system (cf. the dark grey squared areas in the Figures).

The syntactic grammar formalism underlying COMPASS, is *Performance Grammar* [3]. Due to psycholinguistic reasons, it provides a separation into *dominance structures* and *linear ordering*. “Scaffolded writing”—as performed in COMPASS—has the advantage that the students can concentrate on very small problems in L2 sentence production in isolation. For instance,

the learner first inflects a lemma according to the grammatical function without deciding on its position in the constituent and/or in the sentence under construction, resp. At any time during scaffolded writing, partial word ordering can be performed. These results (even if wrong) are kept during further expansions of the dominance structure, e.g. by an Adjective.

In an initial phase, the linguistic vocabulary used in visualizations and feedback messages can be adjusted to the terminology in line with the user’s preferences. As the system provides already lists of different terminologies in English and German, little re-adjustment is necessary—same holds for the teachers in the inclusion classroom preparing the use of IN-COMPASS.

In Fig. 1, we exemplify a potential student action which is not approved by the generator. The disagreement is graphically realized by not unifying the two treelets although the student has moved one on top of the other (as the arrow indicates). In the example, we assume that the student had already successfully constructed a dominance tree for *Anja baut* ‘Anja builds’. In this tree, the student wants to add *ihm* ‘him’ (case DATIVE) at the Direct Object node. In Fig.1, it is still positioned close the desired target leaf below the DOBJ node. However, it does not become attached because word form *ihn* (case ACCUSATIVE) is required instead. Feedback is supplemented by traffic-light inspired color-coding. Red highlights forbidden actions.

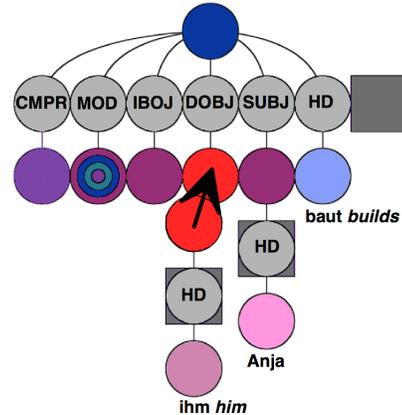


Figure 1. Illustration of a mismatch combining two treelets.

In Fig. 2, the system’s warning reaction to ordering *Anja baut eine Rakete ihm* ‘Anja builds a rocket him’ is delineated. The student has achieved this state by sorting all filled grammatical function nodes in the grey squared area attached to the Head Verb. In Fig. 1, this box is empty because so far, the student has concentrated on the dominance structure. Although word order is wrong, COMPASS does not reject any movement into fields but it indicates errors by inverting color to yellow so that the sen-

¹Quoted from a description of the inclusive design research center at OCAD University, Canada (cf. <http://idrc.ocad.ca/index.php/workshops-aamp-trainings/masters-program/13-resources/technical-glossary/37-grammatical-support-tools> [last visit: 28th of June, 2013]).

tence construction can go on while word ordering is suspended for the time being. In this manner, the system “teaches” even complicated cases such as Scrambling in German subordinate clauses to the student.

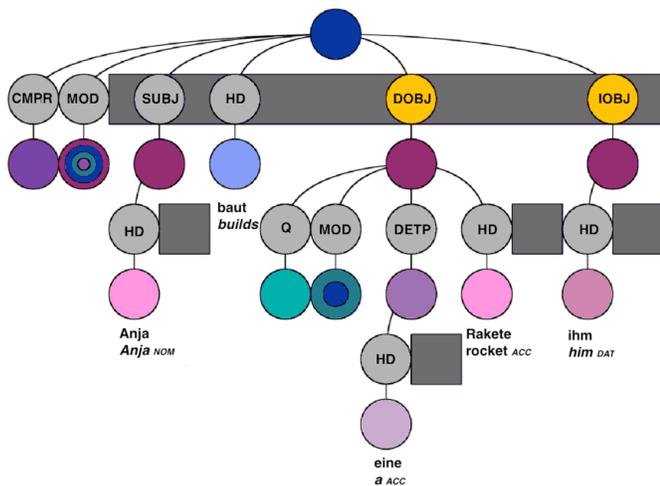


Figure 2. *Word order warning in Anja baut eine Rakete ihm.*

IN-COMPASS provides elementary dialogue features similar to the core version COMPASS, i.e. the students can drag&drop avoiding typos on a tablet with the finger/stylo or on a PC using the mouse/touch pad, resp. As additional feature of IN-COMPASS, a *read-aloud* function is always available. It is indicated by a loud-speaker button for every written text in order to support elementary school children in particular, but also dyslexic pupils in any classroom.

Now we focus on the predefined *layers of granularity* hiding away detailed linguistic information in IN-COMPASS—unless the user asks for. Thus, every pupil in the classroom can work in an individualized manner with the system following personal goals (*self-paced* and *explorative learning*).

Especially, users who are disabled or at a young age should not be confronted with elaborate syntactic trees full of very abstract linguistic terms they do not understand. Nevertheless, there has to be an elementary agreement on the use of words in a sentence between user and system in order to give adequate feedback to any action by the learner (cf. discussions in the CALL literature on parsing-based systems which often have difficulties to provide helpful comments to errors by the learner; see, e.g., [4]). Therefore, IN-COMPASS works with reduced student-composed trees—like COMPASS—instead of sentences typed by the pupil. Thus, we completely avoid dealing with typos, missing words, hardly any punctuation although both systems, COMPASS and IN-COMPASS, resp., allow typing the desired word form. However, due to a nearest match procedure, only corrected lexical frames can be selected/worked with.

Literature

- [1] Harbusch, K., Härtel, J. and Cameran, C.-J. “COMPASS III: Teaching L2 grammar graphically on a tablet computer”, in *Proceedings of SLATE – Speech & language technology in education*, Grenoble, August 2013.
- [2] Harbusch, K. and Kempen, G. “Automatic online writing support for L2 learners of German through output monitoring by a natural-language paraphrase generator”, in M. Levy, F. Blin, C. Bardin Siskin and O. Takeuchi [Eds.], *WORLD CALL*, pp. 128-143, New York: Routledge, 2011.
- [3] Kempen, G. and Harbusch, K. “Performance Grammar: A declarative definition”, in M. Theune, A. Nijholt and H. Hondorp [Eds.], *Computational Linguistics in the Netherlands 2001*, pp. 146–162. Amsterdam: Rodopi, 2002.
- [4] Heift, T. and Schulze, M. (Eds.) (2003). “Error diagnosis and error correction in CALL”, *CALICO Journal*, 20(3).

Basically, a *reduced lexical frame* for an inflected word form exhibits its grammatical functions. The color-encoded fillers in the core system—only providing distinguishable colors from the feedback colors red/yellow/green—remain unchanged as this already allows for easily guiding the combining process without knowing any linguistic term. The naming of a grammatical function is initially provided by the wh-question for the function (e.g., SUBJECT=WHO; cf. Fig. 3 for the lexical frame of *baut* ‘builds’). Any Interrogative Pronoun in the light grey grammatical-function layer—same as any visualized element in (IN-)COMPASS—can be selected to elicit a feedback dialogue. In return, the system provides more details on the function (e.g., different filling options: for a subject, a Personal Pronoun or a complex Noun Phrase). Most importantly, the system wonders whether the learner knows already the—so far hidden—technical term by providing a list of grammatical functions to choose from. In case of a wrong answer, the system—as for any wrong answer—offers the correct answer on demand. Only if the user knew/wanted to know the term, the system suggests to replace the wh-Pronoun by the linguistic term to be used by the system—as it is now learnt by the pupil. Thus, a personal level of detail becomes unveiled to the learner. As a consequence, a mix of Interrogative Pronouns and linguistic terms is displayed regarding to the user’s familiarity with grammar yet.

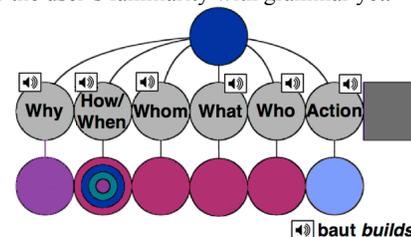


Figure 3. *Reduced lexical frame for baut ‘builds’. Speakers support students with reading problems.*

Moreover, the system allows training of word order variation, where the Subject has to be moved away from its often chosen sentence-initial position. Of course, German speaking pupils are capable of understanding any variation. However, teachers complain about when grading pupils’ essays that the pupils do not exhibit this variation in writing very likely. Therefore, playing around with sentences in order to understand the function of the sentence-initial position in different contexts can be elicited even with very reduced linguistic knowledge.

Due to lack of space, here we can neither elaborate on more linguistic exploration modes (e.g., “teaching”/let pupils find out what it means to be *Head of a phrase* in order to understand why a Preposition is the Head of a PP by playing around with case variation such as in *auf den/dem Bürgersteig* ‘onto/on the sidewalk’) nor discuss the appropriate accommodation to different age groups in IN-COMPASS (e.g., the more but the shorter the feedback by the system is the younger the pupils are in order to avoid overtaxing their attention span).