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Model of a Teacher Assisting Feedback Tool for Marking Free Worded Exercise Solutions

Free worded exercise solutions involve the advantage that students entirely have to resort to their own knowledge. However, their disadvantage is that they cannot be corrected automatically – in contrast to exercises with preset solution possibilities, e.g. multiple choices. This paper outlines these two types of exercise solutions, the methods and some results of a pragmalinguistic analysis of exercise types and their solutions as well as teachers' correction actions of free worded exercise solutions. Afterwards a prototype of a feedback tool model, based on this study and assisting teachers' correction actions, will be briefly introduced.

1 Some Problems Involved in Exercise Solving and their Correction

Teaching and learning systems with implemented exercises can identify errors simply as formal deviations by comparing the learners' input with the solution preset by the teacher (cf. Klemm and Ruda 2003, 183–185; Klemm et al. 2004, 118–125; Narciss et al. 2004). So far texts of free worded solutions have either not been demanded or can merely be evaluated in the simplest way. The following four problems may result:

1. Terms which were not entered by the student in the designated order could make a wrong sense. If the teacher has not considered ambiguous word combinations, a false solution is though assessed as "correct" since the demanded terms are included.

2. If the teacher does not consider correct alternatives, right solutions can nevertheless be marked as "wrong".

3. If a student's answer is assessed as "not completely correct", the corresponding text passages cannot be marked exactly.

4. If the teacher offers sample solutions, he has no control whether the student compared the solutions correctly and if he understood why his own solution may be wrong. Although the teacher can monitor the students through their user profiles of a database, a large number of participants and exercises can make this supervision almost impossible.

Exercises with preset answers can also be corrected via computer without problems. However, there is a high probability that the students do not take them seriously enough, that they are quickly bored, even deliberately enter wrong answers or simply guess the

answer if they do not know the correct solution – particularly if they just do self-tests (cf. Neumann, 2003, 22 p.) which the teacher never views.

Ingenkamp (1993, 200) objects this criticism on solution choice exercises by stating that the possible disadvantage of blind guessing is more than compensated for by the advantage of a considerably larger sample of possible questions. He points out that they are not generally easier than free answer forms but, depending on the offered answers, rather more difficult. According to him the offer of wrong or only partly right answers in connection with the request for correction or critical choice is doubtlessly justified and even desired from a didactical point of view. Moreover, answer choice exercises are compiled and subsequently tested according to a thoroughly elaborated system (Lienert and Raatz, 1998). This is to ensure that the learners need to have certain knowledge in order to solve the exercises correctly. Nevertheless self worded answers offer a considerably bigger learning effect since students entirely have to resort to their own knowledge. This is one of the reasons why multiple choice tasks are no longer permitted for certain examinations (Sächsisches Oberverwaltungsgericht Bautzen, 2002) thus not even necessarily being suitable any more for their preparation.

Furthermore e-learning students' answers are frequently assessed in a very simple way, e.g., "Your answer is unfortunately wrong". All this demonstrates technical shortcomings, the enormous implementation expenditure of a differentiated feedback for every single solution possibilities for all exercises of the (online) course and the involved costs. Therefore a teacher-assisting feedback tool for marking free worded exercise solutions could be helpful in solving these problems. This feedback tool shall connect the advantages of free worded exercise solutions with those processed by the computer.

2 Methods for Analyzing Free Worded Exercise Solutions and their Correction

The development of the feedback tool (Ruda, 2008) involved the classification of types of exercises and solutions. Suitable exercise types and solutions were determined including, e.g., questions which demand standardized answers and which should moreover be brief – i.e. interpretations and argumentations for example are not suitable – and which should follow the descriptive and explicative subject development pattern (cf. Brinker, 2005, 65–69 and 75–79).

Teachers' correction actions were determined by consulting a text corpus consisting of offline university examination questions which demand self worded answers with at least one word. I followed the communicative-pragmatic approach that, under certain circumstances, already considers a word or a sentence as a text (Brinker, 2005, 18). The research methods included the 'think aloud method' (van Someren et al., 1994) and the 'concurrent record analysis' in combination with the 'focused interview' (Karbach and Linster, 1990, 84 p. and 87). During the concurrent recording the expert solves a problem thinking *aloud*, i.e., he says what he sees, feels, thinks and does. Concurrent records document a correct but not complete trace through the problem solving process. All documented actions and observations were really carried out.

However usually some information on the expert's actions is missing. This can be obtained through certain questions in the focused interview.

14 lecturers produced 15 verbal records which were taped, transcribed and described with regard to actions thus providing analytical transcripts. The lecturers have each revised between three and seven papers. Altogether there are 71 papers from 13 special fields with 488 corrected exercises including subtasks. The tape recordings lasted from about nine minutes up to almost two hours. The average recording amounted to one hour.[1]

The correction actions included aspects like: How is the comparison between the lecturer's and student's solution text made? How are mistakes recognized, analyzed, corrected and assessed? Which actions are performed by all lecturers under consideration?

This analysis is based on Austin's (1962) and particularly Searle's (1969) 'Speech Act Theory' and the subsequent related works by Holly et al. (1984), von Polenz (1988) and Brinker (2005).

A deductive research method was employed since it is regarded to be general knowledge that the teacher revises and subsequently assesses students' solutions. The determination of particular (speech) actions that may be formalized is of special importance. The conversion of certain structures into the feedback tool, on the other hand, was based on the inductive approach since concrete and thus specialized examples were translated into general rules.

The intention to implement structures that can be formalized into the feedback tool yielded, amongst others, the following questions: Which actions and speech actions of the lecturers can be simulated by the feedback tool? Which assessments are unambiguous and which are vague? Which of the ambiguous forms can be imitated by the feedback tool? How is the interaction between teacher and feedback tool facilitated? Which suggestions are offered by the feedback tool to the teacher? Which questions have to be asked by the feedback tool? How can the feedback tool be designed in order not to overstrain but to support the teacher when generating correction and assessment standards? How can the feedback tool be designed that the teacher, despite accepting the preset correction and assessment patterns, has the last word in the final assessment? Which rules have to be followed by the teacher? What does the teacher have to know before starting to work with the feedback tool?

It was aimed to design a feedback *tool* which supports teachers in their correction work by making arrangements with them regarding the solution texts and assessments which requires the acquisition of certain rules and initial training. This means that an automatic correction of all solution texts cannot and should not be expected[2]. The feedback tool conception is not based on a flow model but on a scheme which reveals certain correction patterns originating from empirical results. This scheme is to be understood as an ideal type of a model according to Weber (1980, 4). It needs to be emphasized that it was not intended to implement a "phase model" which would force the teacher into a fixed corset

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[1]For reasons of data protection students' answers as well as complete transcriptions are not disclosed.

[2]For the problems and complexity of text understanding and/or -production with computer cf. Winograd and Flores (1992), Rothkegel (1989) as well as Lobin and Lemnitzer (2004).

thus restricting him far too much in his action diversity and freedom (cf. Suchman 1987; Heath and Luff 2000, 9–12). It was rather aimed to implement a "task oriented model" (cf. Brünner, 2000, 27) providing eligible knowledge resources and thus supporting the teachers' current assessment actions in a flexible way.

3 Teachers' Actions of Correcting Free Worded Exercise Solutions

Correcting is often described with only few steps (Kleppin, 2007, 55). However, correcting involves many more actions than merely identifying, marking and possibly improving mistakes or grading. The analysis of the present transcripts has shown that correcting consists of five constitutive partial actions in the following sequence:

1. Grasping the complete student's solution attempt or filtering the propositions to be dealt with

2. Comparison with the expected solution

3. Assessment of the student's solution attempt with regard to the definition of the tasks

4. Total assessment of student's solution and

5. Total assessment of all present solutions of a student.

The potential correction actions also include preparations like writing down expected solutions, compiling a criteria grid and determining the approach – paper by paper or exercise by exercise. The envisioning of exercise questions and solutions can take place before the first, second or third partial action. The third step comprises corrections and comments. Remarks concerning the assessment in general can be made at the beginning and/or the end of the revision.

The most challenging action is the individual assessment of a student's exercise solution, which consists of seven areas:

1. Envisioning of the exercise definition

2. Envisioning of the connection between exercise definition and solution

3. Expressing the first impression

4. Grasping the student's solution attempts

5. Comparison with the expected solution

6. Assessing individual parts of the student's solution attempt and

7. Correcting.

It was revealed that there are complex considerations about correct and incorrect facts and forms mainly in the case of problematic and vague solution attempts, which the teachers tried to solve intuitively employing certain problem solving strategies (Ruda, 2008, 166–185).

A feedback tool can support the teacher in the complex action of correcting since this is effected according to a certain scheme. The constitutive individual assessment actions can be outlined as follows: The feedback tool captures the student's solution attempt, assigns it to the question, compares it with the stipulated solution possibilities and carries out assessments and, if necessary, corrections defined before by the teacher. Therefore the teacher is prompted to thoroughly study the different answer possibilities in advance, thus having more time afterwards to deal with the (problematic) vague solution attempts.

4 Model of a Teacher-Assisting Feedback Tool

Before the first application of the feedback tool, the teacher is given important use guidelines. This includes technical requirements, conceptual conditions for task setting, information on filtering relevant solution contents – according to the subject development patterns like describing (Brinker, 2005, 65–69) –, as well as the functionality and encoding of the offered operators.

4.1 Operators

The teacher arranges solution possibilities and assessments (cf. Figure 1).

First the teacher enters the identification and the text of the exercise. As the next step he sets assessment rules for text parts of the solution. There are two options: He can either encode the rules by himself, which requires exact knowledge and experience about the rules, or, if he lacks this knowledge, he can start the rule assistant. The rule assistant offers seven operators: Boole's operators AND, OR, NOT and, based on them, the operators AND POSSIBLE, OR POSSIBLE, POINT and PREFERRED. They result in pattern matching.

1. The most relevant operator is the AND (UND) Operator (cf. Figure 2). The teacher is asked to enter data, at least one word and/or phrase which have to be part of the solution. Different singular, plural and flexion forms will be considered by setting wildcards: *action, actions → action**.

2. The OR (ODER) operator (cf. Figure 3) is optional like the further operators. The number of words and phrases is at will again. The teacher can enter alternative solution possibilities. If a variant is preferred, it is marked by setting a tick with a mouse click thus activating the

3. PREFERRED (BEVorzugt) operator (cf. Figure 3): The other possible solution is marked as "not optimal" but "nevertheless correct". The feedback tool also displays the optimal solution in this case.
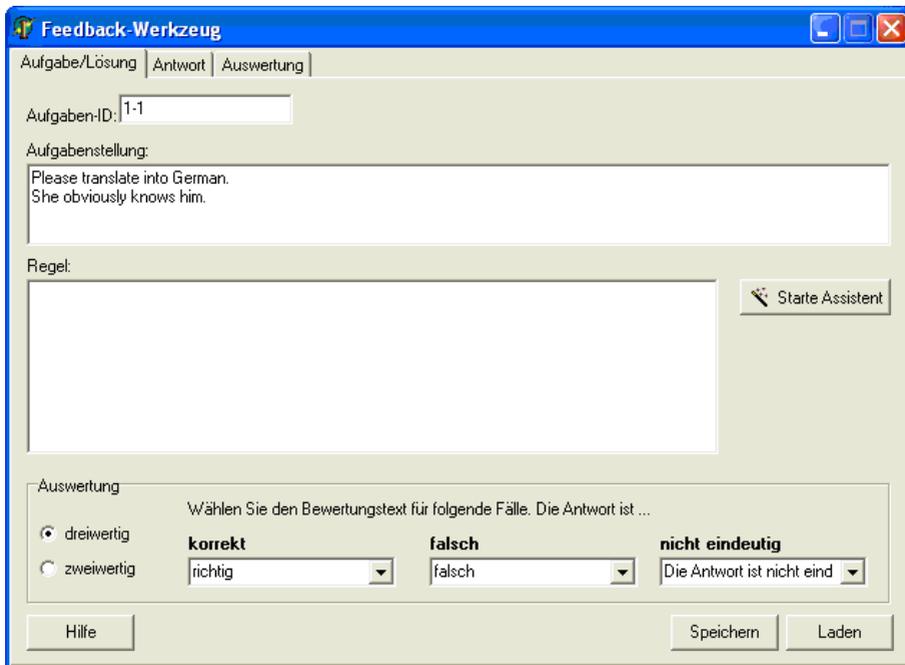
Figure 1: The feedback tool area "exercise/solution".

4. OR POSSIBLE (ODEREVTL) offers the inclusion of solution possibilities which are not completely correct but nevertheless acceptable or which are assessed as "correct" although not necessarily corresponding with the expected expression.

5. With AND POSSIBLE (UNDEVTL) the teacher can display solution possibilities which are right or acceptable provided that they are given in addition to the AND-entry. However, as soon as they are isolated they are no longer assessed as absolutely correct since they may be too general.

6. In the mask POINT (PLUS) the teacher can enter solutions which are better than the expected solution and which are therefore assessed with "outstanding" or honoured with an extra point.
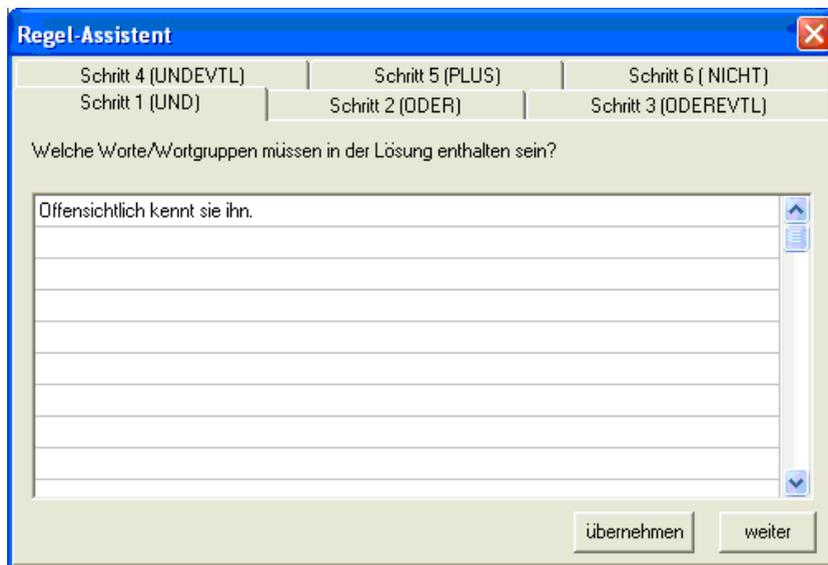
Figure 2: The AND mask.

7. The NOT (NICHT) operator includes expressions which must not be included in the solution. The teacher can enter expressions ranging from an assessment as simply wrong up to an evaluation as a grave mistake.

In the initial stage, the teacher should have all operators demonstrated in the fixed sequence. With some practice he can specifically control the corresponding operators through the file card symbols and finalize the process by clicking the button "apply" (übernehmen). The encoded rules can subsequently be viewed and, if necessary, changed in the field "Rules" (cf. Figure 4).

These operations enable the teacher not only to envision concrete solutions but also to realize incorrect and vague solutions. Thus the rule assistant facilitates the development of an assessment standard which is more extensive than usual. The stipulated rules guarantee a standardized and therefore objective assessment. At this stage the teacher is recommended to consider not only solution possibilities formulated by himself but to likewise consult some of the participants' solutions.
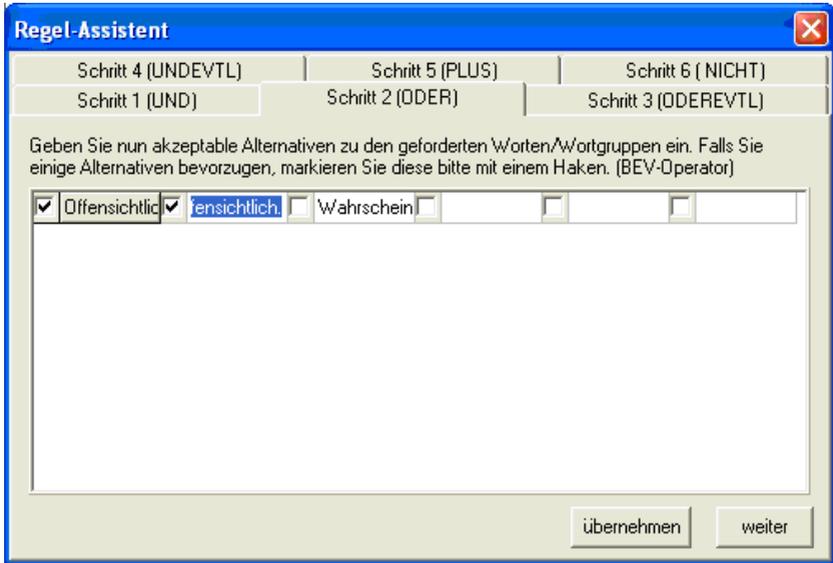
Figure 3: The OR and PREFER mask.

4.2 Evaluation Possibilities and Assessment Texts

Then the teacher has to decide between the two- and three-valued evaluation (cf. Figure 1). The two valued modus merely concerns the categories "right" and "wrong" and is useful if there are only few correct solutions while all the others can be definitely qualified as false. For all other cases the three-valued modus also includes vague solutions. This

Figure 4: The rule field.

selection option is preset since it is mostly applicable with the present text corpus.

In the next step the teacher selects corresponding assessment texts (cf. Figure 1). He can either choose variants from the text corpus or enter his own wording.

4.3 Answer and Evaluation

The teacher copies the student's solution from a data base and pastes it into the answer mask. If, on the other hand, the feedback tool is integrated into a web based training platform, the student's answer appears directly in the answer mask. The feedback tool evaluates the student's answer in accordance with the agreed rules and shows it in the bottom field (cf. Figure 5).

Figure 5: A correct, but not ideal solution.

The feedback tool displays the agreed assessment text, the solution quality in per cent and the expected correct solution since the students' solution concerning the adverb "wahrscheinlich" is not completely optimal. Since from the teacher's point of view this is not bad, the solution quality is nevertheless 100 % (cf. Figure 5).

Students' solution attempts which do not fit into the set framework are returned to the teacher by the feedback tool (cf. Figure 6). The teacher can correct them by hand and

then revise and complement the feedback tool with the corresponding rules and data. Therefore the output of non-revised solutions will be reduced with each learner group.

Figure 6: New answer possibility with interchanged pronoun.

5 Summary and Outlook

This feedback tool is oriented towards free worded exercise solutions whose texts are standardized and brief. It is designed for teachers with a large number of students thus having many exercise solutions attempts to correct.

With the feedback tool the teacher draws up possible answers ranging from *scrupulously correct* over *not quite right/false* up to *absolutely wrong*. Students' solution attempts which do not yet match the rules are returned by the feedback tool for further processing on the part of the teacher.

The feedback tool offers the teacher the following advantages:

- The teacher has to enter relevant solution parts and their corresponding assessment texts only once thus saving time and energy.

- He does not have to be afraid of a fast fall of his concentration since the feedback tool relieves him of the stultifying comparison of recurring patterns thus allowing him a higher degree of accuracy and objectivity in the correction.

- The time and energy saved that way can be spent more effectively for non-stereotype solutions.

  Benefits for the student:

- He is urged to make greater efforts answering the exercise than with multiple choice questions, which includes a more thorough preparation.

- He receives an individual feedback upon which he cannot rest as in the case of sample solutions since he is directly required, e.g., to elaborate on a certain topic or to consult his lecturer.

- With corrected exercises he can strengthen and deepen his knowledge in a better way thus having a more thorough preparation for future examinations.

This feedback tool is still a prototype and not yet available. Future works should for example focus on the employment of a spelling control and a lexical-semantic net like GermaNet (Kunze et al., 2004). Moreover, an application to longer standardized texts could be pursued. Partial assessments within students' solutions shall be realised through quantitative methods (Schmitz, 2000; Mehler, 2004) and fuzzy logic (Rieger, 2002). A detailed description of the feedback tool is presented in Ruda (2008).

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