ReCALL **13** (1): 99–109. Printed in the United Kingdom

© 2001 Cambridge University Press

Error-specific and individualised feedback in a Web-based language tutoring system: Do they read it?

TRUDE HEIFT

Linguistics Department, Simon Fraser University, Burnaby, BC, Canada V5A 1S6

(*e-mail: heift@sfu.ca*)

Abstract

This paper discusses learners' responses to metalinguistic feedback and their strategies in error correction in a Web-based Intelligent Language Tutoring System (ILTS) for German. The system consists of a grammar and a parser which analyses student input and provides error-specific feedback to grammar and vocabulary exercises. Furthermore, the ILTS employs a Student Model that matches feedback messages to learner expertise and provides remedial exercises. Two beginner German classes, 33 students in all, used the ILTS for grammar practice, submitting a total of 4405 sentences for analysis. The results indicate that for the vast majority of sentences (79.5%) students read and attended to system feedback. Moreover, as iterations increased students paid more attention to the feedback messages.

1 Introduction

Immediate and individualised learner feedback has long been recognised as a significant advantage of Computer-Assisted Language Learning (CALL) over more traditional language instruction, but, despite improved computing power and wider availability of authoring tools, CALL grammar exercises still often resemble traditional workbook tasks. More sophisticated error analyses, however, are needed to provide an individualised and meaningful second language practice environment, instead of the multiple choice questions, relatively uninformative feedback, and gross mainstreaming of students characteristic of workbooks.

Garrett (1987) describes four main types of error analyses ranging from the "wrong, try again" model to elaborate analysis requiring Natural Language Processing (NLP). In NLP applications, a parser analyses a sentence according to the lexical items and rules provided in the Target Language (TL) grammar. Any errors found in the sentence can be explained to the learner in a pedagogical and individualised way.

Over the past decade, a number of NLP systems have been implemented (Labrie & Singh, 1991; Levin & Evans, 1995; Loritz, 1995; Hagen, 1994; Holland *et al.*, 1995; Sanders, 1991; Schwind, 1995; Wang & Garigliano, 1992; Yang & Akahori, 1997, 1999; Heift & Nicholson, 2000) which, to some extent, also triggered a shift in the focus of

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

research into the effectiveness of CALL. Whereas early research in CALL emphasised comparisons of CALL vs. traditional face-to-face instruction, over the past decade studies have focused more on comparisons of different CALL programs (Conrad, 1996). For example, a number of studies have investigated metalinguistic feedback vs. traditional feedback in different CALL environments. Nagata (1995, 1996) found that NLP-based intelligent feedback which explains the source of an error is more effective than traditional feedback with learners of Japanese (see also Yang and Akahori, 1999). A further study by Nagata and Swisher (1995) found that the computer can raise grammatical awareness by giving metalinguistic feedback to students. Carroll and Swain (1993), although not specifically investigating learner feedback in a CALL environment, concluded that metalinguistic feedback is more helpful to adult second language learners supporting earlier claims by Schachter (1984, 1986) (see also Lightbown & Spada, 1990). Brandl (1995) researched stronger vs. weaker students' preferences for error feedback options and responses and study results indicate that the learners' language skills influence their preference for a particular type of feedback in CALL programs. Finally, Pujolà (this volume) found that delayed two-step feedback that allows students to discover the source of errors themselves before the program provides the information is perceived as ideal in his reading program ImPRESSions.

While the studies above investigated the learning outcomes and the relative effects of different types of corrective feedback, this paper focuses on learner-computer interaction during the error correction process. In particular, we are examining learners' responses to metalinguistic feedback from an Intelligent Language Tutoring System (ILTS) and their strategies for correcting errors.

Van der Linden (1993), for example, in comparing learner strategies in CALL programs with different levels of feedback, found that students did not try to correct themselves when no feedback about the type of error was provided. Interestingly, she further found that in programs with metalinguistic feedback, lengthy feedback messages (exceeding three lines) were not being read. Finally, students reported that feedback addressing more than one error at a time made the correction process too complex. As was to be expected, individual differences also played a role in the students' strategies for choosing.

From a theoretical point of view, studying learner-computer interaction in error correction will greatly assist in the design of CALL programs (see also Hegelheimer & Chapelle, 2000). From a practical perspective, we can assess the need for a sophisticated error analysis in a CALL system, determine if and how students use metalinguistic feedback, and which learner strategies they apply in response. In our study, we are pursuing answers to the following questions:

(1) Do students read and attend to metalinguistic feedback or overlook it?
(2) What techniques do students apply in error correction in an ILTS?
(3) Do learners believe the system's analysis, or, in the event of an error perform an independent re-analysis?

In the following, we first describe the German Tutor, the Web-based ILTS for German used for this study. We will then describe the participants and outline the tasks and methodology used. Finally we will summarise the results, providing examples of students' output during the practice sessions, before concluding with further research suggestions.

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

2 The German Tutor

The German Tutor is an ILTS that forms the grammar component of a Web-based introductory course for German. The system contains a grammar and a parser which analyses sentences from the student and detects grammatical and other errors. The feedback modules of the system correlate the detailed output of the parser with an error-specific feedback message.

When accessing the system, students can choose from among a pool of different exercise types: drag and drop (for word order practice), dictation, form sentences, vocabulary exercises, etc. For example, in the task given in Figure 1 students are asked to build a sentence from the words provided in their baseforms. The entire interface is kept in German so as not to restrict the Web-based system to a particular native language user group. In addition, we hope that students will become familiar with the target language terminology when practising the grammar and vocabulary. However, students can access an on-line glossary as needed.

The student input in Figure 1 contains an agreement error between the determiner and the noun (there is a mistake in gender with the subject). The student can either correct the error and resubmit the sentence by clicking the Prüfen (check) button, or peek at the correct answer(s) with the Lösung button and/or go on to the next exercise with the Weiter (next) button.

In the case of multiple errors, the system prioritises them, displaying one message at a time so as not to overwhelm the student with excessive error reports. Previous studies (van der Linden, 1993) have found that lengthy error messages tend to distract the student from the task. Error prioritisation follows pedagogical principles to gauge the salience of an error and the focus of a particular exercise (Heift, 1998).

Feedback is also individualised through an adaptive Student Model, which monitors a user's performance over time across different grammatical constructs. This record of strengths and weaknesses is used to tailor feedback messages to learner expertise within a framework of guided discovery learning: a beginner student will receive the most explicit feedback while the instructional messages for the expert will merely hint at the error (see also Elsom-Cook, 1988). The feedback aimed at the beginner will also contain less technical terminology than that for the intermediate and advanced learners (Heift, 1999). For example, Figure 2 shows a feedback message for a beginner student, which indicates a disagreement in gender between a determiner and a noun.

Here, the beginner is presented with a minimum of linguistic terminology. In contrast to Figure 1, the feedback message is also more explicit by telling the student that DER of DER ZEIT is wrong and that the noun is not masculine. It is the purpose of the cur-

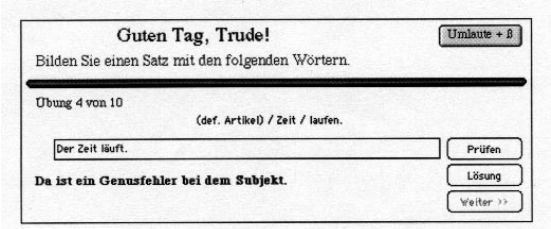


Fig. 1. System feedback for the advanced learner

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

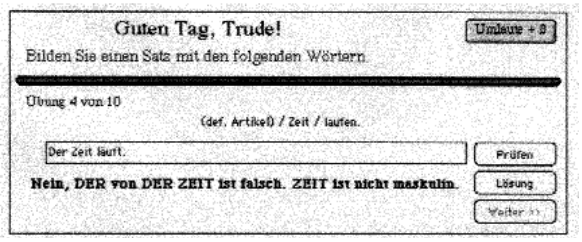


Fig. 2. System feedback for the beginner learner

rent and subsequent studies to determine whether such differentiation is useful and/or what kind of adjustments are needed. In the following section, we will describe the participants and outline the tasks and methodology used.

3 Procedure

During the spring semester 2000, 33 students from two introductory German classes spent three one-hour sessions using the Build a Sentence exercise displayed in Figures 1 and 2.

For data collection, we implemented a computer log to collect detailed information on the student-computer interaction (see Heift & Nicholson, 2000). Students were aware of the computer logging activity but were not shown an example. Students chose an anonymous login ID which they consistently used across all three sessions.

During each of the three sessions, students practised vocabulary and grammar from two chapters for a total of six chapters and 120 exercises. The linguistic structures themselves had been practised in communicative class activities prior to the computer sessions. Students were also already familiar with the grammatical terminology used in the system feedback. The following plan indicates grammar topics for each session:

Chapters 1 and 2: gender and number agreement of noun phrases, subject-verb agreement, present tense of regular verbs, verb conjugations of ‘to be’ and ‘to have’, word order of finite verbs;

Chapters 3 and 4: present tense of irregular verbs, accusative and dative objects, accusative and dative prepositions, two-way prepositions;

Chapters 5 and 6: present perfect, auxiliaries, word order of non-finite verbs, modals, separable prefix verbs.

In the following section, we will discuss the results of our data analysis.

4 Results

4.1 Submission types

The 33 participants accomplished a total of 2795 exercises during the three one-hour sessions. Many exercises required additional submissions before a correct answer was attained. Thus from the system’s point of view, 4405 sentences in total were submitted for analysis.

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

The data in Table 1 show that 40.7% of the sentences were correct on first submission, while the remaining 59.3% contained one or more errors. 52.9% were resubmitted while 6.4% were obtained by requesting the correct answer.

In terms of retries, Table 2 shows that 1791 sentences were correct at first submission while the rest contained errors: 632 sentences, for example, required two tries before the correct answer was found. In 169 of those instances, or 13.4% of the total 1264 submissions, students requested the correct answer. For the remaining, a correction was attempted and the sentence was resubmitted. The data in Table 2 show, however, that some sentences required up to ten submissions until finally correct.

The data also show that students required an average of 1.75 submissions to obtain a correct answer. The number of submissions required also closely correlates with the number of errors in each sentence. As mentioned previously, the system reports only one error at a time to avoid overloading the student. Thus if a sentence contains three errors it tends to require three iterations to inform the students of all errors (unless the students notice some of the errors independently).

As outlined in Table 3, however, 61.7% of the incorrect sentences contained only one error at initial submission. To some extent, the limited number of errors may be due to the fact that students had practised the vocabulary and the grammatical structures in communicative activities in class before. Additionally, each chapter gradually introduced at most two new grammatical concepts.

In the following section, we will discuss the strategies students applied in the error correction process.

4.2 Learners' responses to metalinguistic feedback

In analysing the data, we found five different modes of student reaction to system feedback:

(i) Students corrected the error(s) explained by the system.
(ii) Students corrected an error in the sentence, however, not the one explained by the system.
(iii) Students changed a correct structure.
(iv) Students resubmitted the same sentence.
(v) Students requested the correct answer(s).

In the first mode, the students attend to system feedback and use the ILTS as intended. For (ii)–(v) students disregard the system feedback in one way or another. In (ii), students correct an error successfully, while the student response in (iii) and (iv) does not

Table 1. *Total submissions*

Correct on first submission	1791	40.7%
Resubmissions	2330	52.9%
Answer Requested	284	6.4%
Total Submissions	4405	100%

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

Table 2. *Number of tries and exercises*

Number of submissions	X	Number of exercises	= Total submissions		Answer requested	
1	X	1791	1791	40.7%	0	0%
2	X	632	1264	28.7%	169	13.4%
3	X	240	720	16.3%	75	10.4%
4	X	79	316	7.2%	25	7.9%
5	X	30	150	3.4%	10	6.7%
6	X	11	66	1.5%	3	4.5%
7	X	4	28	0.6%	1	3.6%
8	X	4	32	0.7%	1	3.1%
9	X	2	18	0.4%	0	0%
10	X	2	20	0.5%	0	0%

Table 3. *Error distribution*

# of Errors	Initial submissions	%
1 error	620	61.7%
2 errors	268	26.7%
3 errors	104	10.4%
4 errors	11	1.1%
5 errors	1	0.1%
Total	1004	100%

improve the grammaticality of the sentence. In (v) students do not attempt to ameliorate the error but instead request the correct answer from the system.

Consider the following student samples in 1–5 which illustrate the five learner approaches to error correction:

1. The student corrected the error(s) explained by the system:

Initial submission:	Bianca ist ohne er gegangen.
System feedback:	Nein, ER in der Präpositionalphrase OHNE ER ist nicht richtig. *No, ER in the prepositional phrase OHNE ER is not correct.*
Subsequent submission:	Bianca ist ohne ihn gegangen.
System feedback:	Prima! *Great!*

In example 1 the student made a mistake with the prepositional phrase. The student did not inflect the noun phrase for accusative case as required by the preposition *ohne*.

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

The system explains the error and the student makes the appropriate correction. This strategy was used by all 33 participants at one time or another. However, the first attempt to correct the error was not always successful – in many instances, it took the student a number of tries to obtain a correct answer. For instance, in example 1 the student might have incorrectly changed *er* to *ihm* before providing the correct answer ihn. But in either case, the student attempted a correction that corresponds to the system feedback.

2. The student corrected a different error:

Initial submission:	Sie möchte eine Zweiback.
System feedback:	Vorsicht! Rechtschreibfehler mit ZWEIBACK.
	Watch out! A spelling mistake with ZWEIBACK.
Subsequent submission:	Sie möchte einen Zweiback.
System feedback:	Vorsicht! Rechtschreibfehler mit ZWEIBACK.
	Watch out! A spelling mistake with ZWEIBACK.

In example 2 the input sentence contains two errors: a spelling error and a mistake with the direct object. The student corrects the error with the direct object although the system reports the spelling mistake first. Whether the student read the system feedback but decided to correct the other error, or ignored the feedback message altogether, they appear to have relied on their own intuition to correct the sentence.

Example 2 differs from example 1 in that the student did not attend to system feedback. Instead, s/he corrected an error which was not signaled by the system. This is probably a more sophisticated strategy, and, it is thus not surprising that only seven of the 33 participants ever employed this technique. We also investigated but did not find a correlation between the type of error flagged and which mistake the students corrected first.

3. The student changed a correct structure:

Initial submission:	Die Zeit lauft.
System feedback:	Die Verbform von LAUFT und das Subjekt DIE ZEIT passen nicht zusammen. *The verb LAUFT does not agree with the subject DIE ZEIT.*
Subsequent submission:	Der Zeit lauft.

In example 3 the student again disregarded or did not understand the system feedback, changing the correct gender of the noun phrase instead of correcting the error in subject-verb agreement. Because the feedback is displayed in the target language, the student might have misread the message. The log, however, showed that the nine students who changed a correct structure at some point did respond appropriately to similar feedback messages with other sentences. It may be that students do not read each feedback message equally carefully.

4. The student resubmitted the same sentence:

Initial submission:	Sie essen ein Käsekuchen.
System feedback:	Der Artikel EIN vom direkten Objekt

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

EIN KÄSEKUCHEN ist falsch: das Substantiv ist maskulin und das Verb ESSEN verlang den Akkusativ.
The article EIN of the direct object EIN KÄSEKUCHEN is wrong: the noun is masculine and the verb ESSEN requires accusative.

Subsequent submission: Sie essen ein Käsekuchen.

In example 4 the student ignored the system feedback entirely. Although the system signaled the incorrect use of the direct object, the student resubmitted the same sentence, without making any changes. This mistake occurred with seven students. They might have assumed that the system feedback was wrong, and that resubmitting the same sentence would change or clarify the feedback, or may have made a simple mistake. Without eliciting more information from the students, however, these explanations remain speculative.

5. The student requested the correct answer(s):

Initial submission: Amadeus schenkt seine Tante Blumen.
System feedback: Achtung! Der Artikel SEINE vom indirekten Objekt SEINE TANTE ist nicht korrekt. SEINE ist nicht Dativ.
Careful! The article SEINE of the indirect object SEINE TANTE is not correct. SEINE is not dative.
Possible answer(s): Amadeus schenkt seiner Tante Blumen.

In example 5 the learner did not attempt any corrections to the sentence, instead immediately asked to be shown the correct answer. There were also three participants who

Table 4. *Student response across iterations*

Iteration	Action taken									
	Attend to Feedback		Correct Another Error		Mistakes				Request Answer	
					Change a Correct Sentence		Submit Same Sentence			
2nd	463	73.3%	0	0%	0	0%	0	0%	169	26.7%
3rd	387	80.6%	1	0.2%	6	1.2%	11	2.3%	75	15.6%
4th	200	84.4%	6	2.5%	3	1.3%	3	1.3%	25	10.5%
5th	104	86.7%	0	0%	2	1.7%	4	3.3%	10	8.3%
6th	47	85.5%	1	1.8%	1	1.8%	3	5.5%	3	5.5%
7th	22	91.7%	0	0%	0	0%	1	4.2%	1	4.2%
8th	27	96.4%	0	0%	0	0%	0	0%	1	3.6%
9th	14	87.5%	2	12.5%	0	0%	0	0%	0	0%
10th	16	88.9%	2	11.1%	0	0%	0	0%	0	0%
Total	1280	79.5%	12	0.8%	12	0.8%	22	1.4%	284	17.5%

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

never requested the correct answer, but instead corrected every single error until the bitter end (as mentioned previously, some sentences required up to ten iterations).

Table 4 displays the breakdown for each learner technique. The data indicate that students attended to system feedback, on average, in 79.5% of all instances, least of all (73.3%) on the first resubmission but increasingly more so after each resubmission. Generally, given multiple errors students corrected the errors explained by the system first. This suggests that students read the feedback message rather than independently corrected an error that coincided with the system feedback. For instance, for sentences which needed up to nine and ten submissions students did not change a correct structure, submit the same sentence, or request a correct answer at all, in other words, use of other strategies diminished.

Across individuals, we noticed that 30 out of the 33 students requested the correct answer at some point. Among those students were found both high and low performers. High performers might have more confidence in their own work than in the accuracy of the computer system and thus if the system reports an error they tend to look up the correct answer to resolve the conflict. Moreover, these students might feel that they learn from simply reading the correct answer more than from the iterative correction process. As for the weaker students, it is possible that they find it more frustrating working through the error correction process. Interestingly, though, it seems that after a few iterations all students became more engaged in working at the correct answer.

The data in Table 4 indicates that the majority of the corrections followed suggestions made by the system (79.5%). Mistakes decrease to zero by the eighth iteration, perhaps because students accepted the need to pay closer attention to the feedback.

Finally, learners occasionally corrected errors that were not explained by the system in the same feedback message (0.8%). As previously noted in Table 3, however, only about 40% of the sentences contained more than one error, presenting few opportunities to do so.

While the percentages for correcting other errors is the highest after nine and ten resubmissions, the data are too small to draw any conclusion. It is possible, however, that with that many resubmissions the student is merely guessing at the correct answer, thereby making random changes and correcting other errors by accident.

5 Conclusions

In this paper, we discussed learners' responses to metalinguistic feedback in an ILTS for German. The data show that for the vast majority of sentences (79.5%) students attended to system feedback. For these sentences students corrected only the errors explained by the system while initially ignoring further errors, in the case of multiple errors. This reinforces the fact that students indeed read the feedback messages rather than independently corrected errors that coincided with the system feedback. Finally, as iterations increased students paid more attention to the feedback messages.

Students also corrected errors that were not explained by the system in the same feedback message (0.8%) while they disregarded the errors completely for 2.2% of all submitted sentences. Finally, for 17.5% of the faulty sentences, or, 6.4% of all submitted sentences students requested the correct answer(s) from the system. During the three practice sessions three students never requested a correct answer, resubmitting sentences up to ten times to obtain a possible answer.

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

Our study prompts a number of suggestions. Firstly, our data show that students attend to metalinguistic feedback and correct their output accordingly, despite the opportunity to access the correct answer at any time. Thus, CALL programs can provide a meaningful practice environment – one in which students appreciate being informed about their errors and involved in a meaningful learner-computer interaction. Secondly, our data confirm previous studies which suggest that learner control is important. Our study indicates that the quick route to the correct answer was not over-used, and, in fact, was shunned by three students. Most of the time, students opted to work through the iterative correction process. Obtaining a correct answer on demand, however, serves to moderate student frustration.

Intriguing questions remain open, however, or speculative: for example, it would be interesting to investigate to what extent learner level influences learners' responses to metalinguistic feedback and strategies in error correction. In this study we only superficially considered differences among beginner, intermediate, and advanced learners, in particular, as they apply to the system's ability to modify feedback accordingly. Reasonably, variations among different learner levels could be expected.

References

Brandl, K. K. (1995) Strong and Weak Students Preference for Error Feedback Options and Responses. *Modern Language Journal*, **79**: 194–211.

Carroll, S. and Swain, M. (1993) Explicit and Implicit Negative Feedback. An Empirical Study of the Learning of Linguistics Generalizations. *Studies in Second Language Acquisition*, **15**: 357–386.

Conrad, K. B. (1996) CALL-Non-English L2 Instruction. *Annual Review of Applied Linguistics*, **16**: 158–181.

Elsom-Cook, M. (1988) Guided Discovery Tutoring and Bounded User Modelling. In: Self, J. (ed.), *Artificial Intelligence and Human Learning*, Bristol: J. W. Arrowsmith Ltd., 165–178.

Garrett, N. (1987) A Psycholinguistic Perspective on Grammar and CALL. In: Smith, W. F. (ed.), *Modern Media in Foreign Language Education: Theory and Implementation*. Lincolnwood, IL: National Textbook, 169–196.

Hagen, L. K. (1994) Unification-Based Parsing Applications for Intelligent Foreign Language Tutoring Systems. *CALICO Journal*, **12** 2: 5–31.

Hegelheimer, V. and Chapelle, C. (2000) Methodological Issues in Research on Learner-Computer Interactions in CALL. *Language Learning & Technology*, **4** (1): 41–59.

Heift, T. and Nicholson, D. S. (2000) Theoretical and Practical Considerations for Web-based Intelligent Language Tutoring Systems. In Gauthier, G., Frasson, C. and VanLehn, K., (eds.) *Intelligent Tutoring Systems. 5th International Conference, ITS 2000*, Montreal, Canada, June 2000: 354–362.

Heift, T. and McFetridge, P. (1999) Exploiting the Student Model to Emphasize Language Teaching Pedagogy in Natural Language Processing. *Proceedings of the Workshop on Computer-Mediated Language Assessment and Evaluation in Natural Language Processing, ACL/IALL'1999*, Maryland: 55–62.

Heift, T. (1998) Designed Intelligence: A Language Teacher Model. *PhD Dissertation*, Simon Fraser University, Canada.

Holland, M. V., Kaplan, J. D. and Sama, M. R. (eds.) (1995) *Intelligent Language Tutors: Theory Shaping Technology*. Mahwah, New Jersey: Lawrence Erlbaum.

Labrie, G. and Singh, L. P. S. (1991) Parsing, Error Diagnostics, and Instruction in a French Tutor. *CALICO Journal*, **9**: 9–25.

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press

Levin, L. S. and Evans, D. A. (1995) ALICE-chan: A Case Study in ICALL Theory and Practice. In: Holland *et al.*, *op. cit.*: 77–99.

Lightbown, P. M. and Spada, N. (1990) Focus-on-Form and Corrective Feedback in Communicative Language Teaching. *Effects on Second Language Teaching. SSLA*, **12**: 429–448.

Loritz, D. (1995) GPARS: A Suite of Grammar Assessment Systems. In Holland *et al.*, *op. cit.*: 77–99.

Nagata, N. (1996) Computer vs. Workbook Instruction in Second Language Acquisition. *CALICO*, **14** (1): 53–75.

Nagata, N. (1995) An Effective Application of Natural Language Processing in Second Language Instruction. *CALICO*, **13** (1): 47–67.

Nagata, N. (1991). Intelligent Computer Feedback for Second Language Instruction. *Modern Language Journal*, **77**: 330–338.

Nagata, N. and Swisher, V. (1995) A Study of Consciousness-Raising by Computer: The Effect of Metalinguistic Feedback on Second Language Learning. *Foreign Language Annals*, **28** (3): 337–347.

Pujolà, J.-T. (2001) Did CALL Feedback Feed Back? *ReCALL*, **13** (1).

Sanders, R. (1991) Error Analysis in Purely Syntactic Parsing of Free Input: The Example of German. *CALICO*, **9** (1): 72– 89.

Schachter, J. (1986) The Epistemological Status of Second Language Acquisition. *Second Language Research*, **2**: 120–159.

Schachter, J. (1984) A Universal Input Condition. In: W. Rutherford (ed.), *Language Universals and Second Language Acquisition*. Amsterdam: John Benjamins, 167–183.

Schwind, C. B. (1995) Error Analysis and Explanation in Knowledge Based Language Tutoring. *Computer Assisted Language Learning*, **8** (4): 295–325.

Van der Linden, E. (1993) Does Feedback Enhance Computer-Assisted Language Learning. *Computers & Education*, **21** (1-2): 61–65.

Wang, Y. and Garigliano, R. (1992) An Intelligent Language Tutoring System for Handling Errors Caused by Transfer. In: Frasson, C., Gauthier, G. and McCalla, G. I. (eds.), *Intelligent Tutoring Systems. Lecture Notes in Computer Science*. Springer-Verlag, 395–404.

Yang, J. and Akahori, K. (1999) An Evaluation of Japanese CALL Systems n the WWW. Comparing a Freely Input Approach with Multiple Selection. *Computer Assisted Language Learning*, **12** (1): 59–79.

Yang, J. and Akahori, K. (1997) Development of Computer Assisted Language Learning System for Japanese Writing Using Natural Language Processing Techniques: A Study on Passive Voice. Proceedings of the Workshop Intelligent Educational Systems on the World Wide Web, *8th Conference of the AIED Society*, Kobe, Japan. http://www.contrib.andrew.cmu.edu/~plb/AIED97_workshop/Yang/Yang.html

https://doi.org/10.1017/S095834400100091X Published online by Cambridge University Press