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Inspectable learner reports for web-based language learning

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Abstract

In this paper we present the Report Manager of our Web-based tutoring system for German – an interface to a persistent learner report that students can inspect and manipulate. The learner report collects and retains information on the learner's progress and performance that is saved between visits. It also provides access to a journaling system that records prior inputs along with detailed error analysis, and a bookmarking system that tracks exercise completion. Finally, results can be printed or emailed to an instructor. In the Fall semester 2003, we conducted a study with 87 learners of German to investigate how their study habits are affected by an inspectable learner report. Our study indicates that students reviewed their learner profiles frequently – 33 times on average over the course of a semester – and that 70% of the students repeated exercises after having inspected their learner profile. So, while detailed user profiles and performance tracking are invaluable tools for CALL researchers, our study suggests that students also utilize and are influenced by the information.

1 Introduction

While online language learning holds much promise, expanded use of the Internet has generally meant less, rather than more, emphasis on individualized instruction. For example, learner progress and performance assessment is sparse in many online systems, or, when present, does not persist across sessions (visits). Learners commonly return to a site puzzled as to which exercises they have previously completed and what mistakes were made.

It is interesting, however, that over the past few years tracking technology has become sufficiently sophisticated to potentially address these pitfalls of online applications. But the vast amounts of data that are being collected with modern tracking tools are generally not shared with learners. Instead, the information is most commonly used for research and program design purposes. There exists a body of research, however, which suggests that this kind of information, frequently contained in a learner model, has a motivating effect on learners if shared with them (see Mitrovic & Martin, 2002).

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In this article we describe the *Report Manager* of our online CALL system. The *Report Manager* is an interface to a persistent learner report that students can inspect and manipulate. The learner report collects and retains information on the learner's progress and performance that is saved between visits. It also provides access to a journaling system that records prior inputs along with detailed error analysis, and a bookmarking system that tracks exercise completion. Finally, results can be printed or emailed to an instructor.

During the Fall semester 2003, we conducted a study with 87 learners of German to determine their use of our *Report Manager*. We were curious to what extent their study habits are affected by an inspectable learner report. More specifically, we were interested in pursuing the following research questions:

1. How frequently do students access the *Report Manager*?
2. For which exercise types and at which point do students access the *Report Manager?*
3. What are possible factors that influence students repeating entire exercise sets?

In the following, we first discuss the theoretical issues surrounding our study. In section 3, we describe our study participants, study procedures, and then explain the *Report Manager.* In section 4, we present our results and address further research questions. Concluding remarks follow in section 5.

2 Inspectable learner reports

Computer programs for tracking student-computer interaction have become a popular research tool in Second Language Acquisition (SLA). By now, many Learning Management Systems (LMS) and CALL programs come with readily equipped logging capabilities (e.g. WebCT, Blackboard, Système-D, J-Edit and Trace-It, Sequitur, Jumbler) and researchers have also designed their own tracking devices, mainly to overcome the apparent limitations associated with off-the-shelf software (see Heift & Nicholson, 2000). While off-the-shelf software is time-saving, researchers are, at the same time, restricted in the kinds of data they can track.

Tracking has been used extensively to monitor student writing and to record student navigation patterns (see Glendinning & Howard, 2003; Roed, 2003; Thorson, 2000; Johns & Lixun, 1999; Scott & New, 1994; Sullivan, Kollberg & Pålson, 1998). The studies generally suggest that learner strategies, learner variables and system design features play a vital role in how students use a CALL program. For example, with respect to student writing, New (1999) found that both good and poor writers revise their output but students more commonly make surface-level changes than revise the content. Concerning navigational patterns, Beasley and Waugh (1997) showed that learners tend to use a systematic top-down, left-to-right navigation strategy and suggested that this preference was not only due to the constraints in the design of the environment but also to a strong cultural bias (see Desmarais *et al*., 1998).

With respect to its benefits, Romano-Hvid and Krabbe (2003) list the following reasons for employing tracking in the CALL classroom (see also Hwu, 2003; Hegelheimer, 2002):

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- automatically collects research data
- enables research in CALL and SLA
- tests teaching methodology
- provides automatic feedback on the quality of the courseware
- facilitates real time tailoring of the courseware to the user.

In this article, however, we suggest an additional, and quite distinct benefit from tracking learner data. We are proposing an inspectable user report whereby learners have access to the initially tracked data for self-inspection.

In order for any CALL system to provide a learner with an individualized experience, the system, among others, must build some model of the learner's knowledge of the learning content, and learner variables (Heift & Schulze, 2003). For example, Bull (1994) developed a system that teaches clitic pronoun placement in European Portuguese. The student model is based on the system's and the student's belief measures, language learning strategies, and language awareness. The system's belief measure is comprised of the proportion of incorrect/correct uses of the rule; the students provide the data for the student's belief measure, being required to state their confidence in their answer when entering sentences. Learners also identify their preferred learning strategies when using the program. According to Bull (1994), language awareness is achieved by allowing the student access to all information held in the system.

Recent studies confirm that learning can be facilitated by allowing the learner to view their learner model as this promotes self-assessment, one of the meta-cognitive skills necessary for effective learning (Mitrovic & Martin, 2002). Hansen and McCalla (2003) further suggest that students share their learner model with others and, accordingly, they may gain a greater understanding of their problems and their progress by directly comparing it to that of their peers.

A number of researchers have investigated the benefits of open learner models. Zapata-Rivera and Greer (2002), for example, suggest several ways to interact with models in order to support reflection, negotiated assessment, and knowledge awareness. For instance, they believe that reflecting upon the learner model facilitates a new learning process. In their system ConceptLab, students can create and inspect their model. Morales *et al*. (1999) further show that it is vital to construct leaner models that can be studied and understood by the learner.

Open learner model systems can largely be divided into two categories: systems with inspectable learner models provide some view of the system's model to the students while a system with a negotiable learner model allows some scope for the students to change their learner model. Some learner models are merely a representation of the student's knowledge in a small number of key areas. Other learner models can be much more complex and may contain a representation of the student's learning styles and strategies as well as learner variables. Modeling more student attributes will provide the system with more information and, in turn, the user with a more individualized experience; however, the difficulty of obtaining and using the information is increased (see Mabbott & Bull, 2004).

At present, our *Report Manager* only contains information on the student's performance and, for this reason, it consists of a learner report rather than a learner model. However, it is possible to expand our *Report Manager* to include a more comprehensive

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learner model, one that entails a representation of the student's learning styles and strategies as well as learner variables.

In the following section we discuss our *Report Manager* and describe a study in which we investigated how students utilize and are influenced by the information.

3 Our study

3.1 Study participants and procedure

In the Fall semester 2003 we conducted a study with 87 learners of German to investigate their use of our *Report Manager,* our interface to an inspectable learner report. The thirty male and 57 female students were enrolled in German language courses at university. Thirty-eight beginners and 49 advanced beginners participated in the study.

The online CALL program used in this study is an Intelligent Language Tutoring System, a parser-based system for German that accompanies the fourteen chapters of *Deutsch*, *Na Klar!*, a commonly used textbook for German beginners. The *E-Tutor* contains different exercise types for both vocabulary and grammar practice. In addition, students can view pictures, explore related websites and study audio dialogues. For all exercise types, the *E-Tutor* provides error-specific feedback and additional help options in the form of a dictionary and individually tailored grammar help (see Heift (2002, 2003) for a detailed overview of the system).

After a pre-test students used the *E-Tutor* for a period of 15 weeks. Each student completed a total of five chapters on average. Each chapter contains approximately 50 individual exercises which in total take approximately three hours to complete. A final post-test and questionnaire completed the data set. The entire study was conducted online (see http://www.e-tutor.org).

3.2 Pre-test

In the pre-test we collected some background information on the study participants and assessed their knowledge of German. For background information, students provided their native language, gender, and level of computer literacy. Our language skill assessment was intended to evaluate initial student placement that took place prior to students registering in the university courses. The student IDs of our log revealed in which courses students were registered.

In the pre-test, students had to respond to 24 prompts that contained vocabulary and grammar constructions from beginner to intermediate level. The analysis of the pre-test indicated that there were very few discrepancies between initial student placement and our assessment. However, for the purpose of our data analysis we adjusted the student level on the basis of the pre-test we administered.

3.3 Practice phase

During the practice phase, study participants used the *E-Tutor* for the entire semester (13 weeks + two weeks of final exams). As they progressed through the course, they completed the exercises provided in each chapter. Students had access to the online

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system at any time and they could complete the exercises as often as desired. They were asked to mail in their results of each chapter to their instructors, but they were not graded on their performance.

For the purpose of this study, we considered four different exercise types: build-a-sentence, dictation, fill-in-the-blank, and translation. For the build-a-sentence exercise type, words are provided in their base forms and/or contain prompts and students are asked to construct a sentence. For instance, in the example given in (1), students need to provide the correct indefinite article einen (masculine, accusative), conjugate the verb essen, and apply the correct word order (verb second).

(1) er / (indef. article) / Apfel / essen.
he / (indef. article) / apple / to eat.
Er isst einen Apfel.
He is eating an apple.

For the dictation exercise, students listen to a dialogue and type out the sentences one at a time. The fill-in-the-blank exercise type consists of sentences with a single blank where students fill in a missing word according to a prompt. For the translation exercise, students translate an English sentence into German (see Heift, 2004).

3.3.1 The report manager

The *E-Tutor* contains an extensive tracking system. Besides a unique student ID and a time stamp, the log records the entire interaction between the computer and the student. This includes the task, the student input, the system feedback, and navigation patterns in cases where students access their learner profile or click on a link for additional information relevant to their error(s).

In previous studies, the data collected by the *E-Tutor* have been primarily used for quality control of the online system and research purposes. More recently, however, we created an inspectable learner report with the following functions:

1. The learner report bookmarks and tracks exercise completion.
2. It collects and retains information on the learner's progress and performance that is saved between visits.
3. It contains a journaling system that records prior inputs along with a detailed error analysis that can be printed or emailed to an instructor.

Figure 1 shows the typical content of a chapter in the *E-Tutor*. Besides different exercise types for both grammar and vocabulary practice, the *E-Tutor* provides additional chapter-related resources. For example, students can study the online grammar content for each chapter, access related Web links and pictures, and listen to the chapter vocabulary.

The *Report Manager* provides the interface to our inspectable learner report. The content page for each chapter provides a link to the journaling part of the *Report Manager* ("manage your reports"), followed by a brief explanation of the symbols used in our system.

The *Report Manager* provides access to a bookmarking system that tracks exercise

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Fig. 1. Content page for a chapter in the E-tutor.

completion for each user and exercise set. The pencil icon that, for instance, is shown in front of the link "listen to a story about Gabi", indicates that the listening exercise is in progress but the student has not yet completed it. For each exercise type, the system saves the information for each student and session between visits to the site. This allows students to always continue their work from their last visit. The report card icon displayed in front of "fill in the blank" and "multiple choice" under "practice your vocabulary", indicates that the exercise set has been completed. The dotted square icon that, for instance, appears in front of "translation" under "practice your grammar", indicates that the student has not yet accessed this particular exercise type.

In addition to the learner's progress, the *Report Manager* also saves information on the student's performance. The journaling system of the *Report Manager* records prior inputs along with detailed error reports. Figure 2 shows the summary page for the exercises that are either completed or in progress. Exercise types that the student has not yet worked on do not appear in the report.

Our *Report Manager* displays the name of the exercise, the completion date, and a final performance summary for each exercise. For example, on the build-a-sentence task in Figure 2 the student scored 80%. For exercises that are in progress students can resume the exercise ("resume"). If a student chooses to repeat an entire exercise set the associated report has to be deleted first by clicking the "delete" button.[1] This will delete the previously saved summary of the student's performance of this exercise type. Finally, students can also obtain a more detailed summary of their performance on a completed exercise type by clicking on "view report". Figure 3 shows a comprehensive report for the build-a-sentence exercise type. In addition to the completion date, students

1 For computational and pedagogical reasons, the system only stores the current report for each exercise type.

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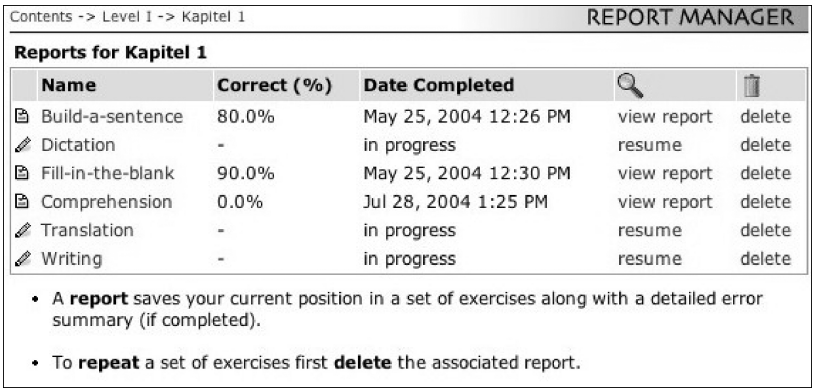


Fig. 2. Progress report and performance Summary.

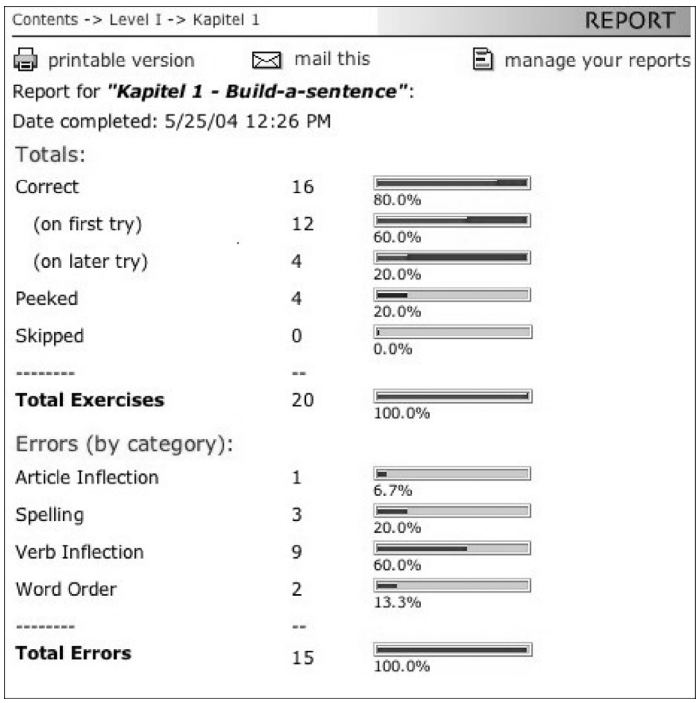


Fig. 3. Viewing an error report.

receive a summary of the total number of correct, incorrect, peeked and skipped exercises followed by a detailed break-down of their errors.

In Figure 3 the student did not skip any exercises but for four of them, s/he looked up the answer (peeked) at some point in the error correction process. In the event of an error, students have a number of options in the *E-Tutor*. The student can either correct the error and resubmit the sentence, or peek at the correct answer(s), and/or skip to the

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next exercise. If the student chooses to correct the sentence, it will be checked for further errors. The iterative correction process continues until the sentence is correct.

The summary in Figure 3 further shows that for twelve out of the twenty exercises, the student obtained the correct answer on first try. For the remaining four exercises, the student required several tries, committing the errors given in the error breakdown in the lower half of Figure 3: the student made mistakes with the articles, spelling, verbs, and word order.[2]

The results for each exercise type can also be printed or emailed to an instructor. In addition to individual student assessment, the instructor can compile the information into a class error history by combining the errors that were made by all students in the class.

3.4 Post-test and questionnaire

The post-test contained the same format as the pre-test. In addition, we also administered a questionnaire that elicited student responses to the system and its unique features. Student responses relevant to the study discussed here will be presented in section 4.3.

4 Results

When accessing the *Report Manager*, students have three options:

1. For all exercises that are in progress or are completed, students can *manage* their reports by reviewing the current status of each exercise type (in progress vs. completed) and a summary page of their performance (Figure 2). Moreover, the summary page presents the students with two further options:[3]
2. They can *view* a detailed break-down of their performance for each exercise type (Figure 3), or
3. students can repeat an entire exercise set; however, they first need to *delete* the previous one (link in Figure 2).

Accordingly, in our study we were interested whether students access the *Report Manager* and, if so, how often. We analyzed our data with respect to *manage, view*, and *delete* representing the three options described above.

The data given in Table 1 show that all students accessed (manage) the summary page of the *Report Manager* when using the *E-Tutor* with a total low of 6 and a total high of 99 times. However, not all students *viewed* and *deleted* exercise sets. The data indicate that 14 out of the 87 students (16.1%) never viewed a detailed error break-down of their performance and 26 of the 87 students (29.9%) never repeated, that is, deleted an exercise set. Please note, however, that students cannot *delete* or *view* exercises in the *Report Manager* unless they access the summary page (Figure 2). Thus each time they *view* or *delete* they also manage. This explains the differences in student access for manage vs. view and delete.

2 We are currently expanding our Report Manager to allow students to view the sentences that contained errors and subsequently redo them.

3 Students can also resume an exercise, however this is not relevant to the current study.

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Table 1. *Access of our Report Manager*

N = 87	Access of our *Report Manager*		
	Manage	View	Delete
Low	6	0	0
High	99	57	88
Median	32	6	4
Average per Student (Mean)	33.4	9.6	9.1
Total access for all students	2908	835	791

Our data further indicate that, for the entire semester, students accessed the *Report Manager* 2,908 times, among which 835 times were for *view*, and 791 times were for *delete*. Given the results provided in Table 1, we were interested in the factors that might influence student access of the *Report Manager*. For the current study we considered exercise type and several learner variables which we discuss in the following sections.

4.1 Different exercise types

Throughout the semester, students worked on four different exercise types. Accordingly, we were also interested in the distribution of student access of the *Report Manager* for the four different exercise types. The data displayed in Table 2 show that access of the *Report Manager* was fairly evenly distributed among all exercise types (65.2%, 64.4%, 65%, 61.7%). However, students more often *managed* (64.1%) and *viewed* (18.4%) their reports than they *deleted* (17.4%) them.

It is interesting to note, however, that for both the fill-in-the-blank and the translation exercises students *deleted* their reports more often than they *viewed* the detailed error break-down of their performance. However, the number of exercises per exercise type and chapter might help to explain the differences in student access, therefore suggesting that the results are context-dependent.

Table 3 indicates that, for each chapter, students translate 5-7 individual sentences. In contrast, the build-a-sentence exercise type always contains 20 sentences. Accordingly, if a student chooses to delete an exercise type and repeat it, the build-a-sentence will require the most time because it contains the most individual exercises, possibly inhibiting students from doing so. The dictation and fill-in-the-blank exercise types contain almost the same amount of exercises but repeating a fill-in-the-blank exercise is again less time-consuming. Only one word has to be entered as opposed to listening to and

Table 2. *Access for each exercise type*

	Build-a-Sentence	Dictation	Fill-in-the-Blank	Translation	Total
Manage	935 (65.2%)	577 (64.4%)	701 (65.0%)	695 (61.7%)	2908 (64.1%)
View	294 (20.5%)	173 (19.3%)	183 (17.0%)	185 (16.4%)	835 (18.4%)
Delete	204 (14.2%)	146 (16.3%)	195 (18.1%)	246 (21.8%)	791 (17.4%)

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typing out a whole dialogue.

For each student, we calculated the mean of total access of the *Report Manager* and the number of submissions per exercise type and applied a one-way repeated measures ANOVA. The test of within-subject effects with respect to the four exercise types, given in Table 4, indicates a statistically significant difference ($F = 6.683$; $p = 0.000$).

To determine inter-group variation, a pair-wise comparison with significance level .05 revealed a significant difference between all exercise types except for dictation and fill-in-the-blank, dictation and translation, and fill-in-the-blank and translation. The detailed statistics are displayed in Table 5.

As noted in Table 2, however, the biggest difference with respect to the four exercise types can be found in the number of deletions, in particular with build-a-sentence and translation (14.2% vs. 21.8%). Why are students deleting and thus repeating exercises? What are some of the likely factors that influence their behaviour?

4.2 Exercise deletion

In shedding light on exercise deletion, we first determined whether students generally complete a set of exercises before they delete it or whether they delete it while still in progress.

The data displayed in Table 6 show that, for all exercise sets, students delete them more often when completed. A possible explanation is that students only learn about their final score and the error-breakdown once they finished the entire exercise set. The differences between deletion of exercises in progress vs. completed are more prominent with fill-in-the-blank and translation than with the build-a-sentence and the dictation exercise types, but, again, this might be due to the amount of time required to repeat an

Table 3. *Number of exercises per exercise type*

	Number of exercises per exercise set
Build-a-Sentence	20
Dictation	9-13
Fill-in-the-Blank	10
Translation	5-8

Table 4. *Results for the four exercise types (* $p < 0.05$)*

	Tests of Within-Subjects Effects			
Exercise Types		df	F	Sig.
	Sphericity Assumed	2	6.683	.000*
	Greenhouse-Geisser	2.399	6.683	.001*
	Huynh-Feldt	2.473	6.683	.001*
	Lower-bound	1.000	6.683	.011*

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Table 5. *Results of a pairwise comparison of the four exercise types (* $p < 0.05$; Std. Error 0.000)*

	Build-a-Sentence	Dictation	Fill-in-the-Blank	Translation
Build-a-Sentence		0.000*	0.000*	0.013*
Dictation	0.000*		0.167	0.072
Fill-in-the-Blank	0.000*	0.167		0.718
Translation	0.013*	0.072	0.718	

Table 6. *Point of access of the report manager*

		Build-a-Sentence	Dictation	Fill-in-the-Blank	Translation	Total
Delete	in progress	85 (41.7%)	63 (43.2%)	46 (23.6%)	62 (25.2%)	256 (32.4%)
	completed	119 (58.3%)	83 (56.8%)	149 (76.4%)	184 (74.8%)	535 (67.6%)
Total		204 (100%)	146 (100%)	195 (100%)	246 (100%)	791 (100%)

exercise set. Due to the complexity of the task and the number of exercises per chapter, build-a-sentence and dictation require considerably more time for task completion. Here students might decide to delete while in progress and before they have even seen their final results.

For exercise deletion, we also applied a one-way repeated measures ANOVA and the test of within-subject effects with respect to the four exercise types, given in Table 7, also indicates a statistically significant difference ($F = 6.262$; $p = 0.014$).

To determine inter-group variation, a pair-wise comparison with significance level .05 revealed a significant difference between deletion of exercises in progress vs. completed. The detailed statistics are displayed in Table 8.

So far, our data have shown that all students access the information provided by our *Report Manager*. Moreover, there are significant differences with respect to the four exercise types and the point at which students delete exercises. Of further interest are the factors that might influence students deleting and thus repeating entire exercise sets. For the current study we considered language proficiency, gender, computer literacy, native language, and number of mistakes committed while working on the exercises.

4.3 Learner variables

Our statistical analysis of possible learner variables that might influence students repeating exercise sets revealed that language proficiency, gender, computer literacy, and the native language of the student are not statistically significant factors. However, when applying a Pearson's Correlation Coefficient we found a significant correlation at the 0.05 level between number of deletes per student and number of mistakes. The statistics presented in Table 9 indicate that, on average, students deleted 9.1% of the exercises and made 326 mistakes over the course of the semester. The data analysis given in Table 10 further reveals that a significant correlation between number of deletes and number of

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Table 7. *Results for the four exercise types (* $p < 0.05$)*

		Tests of Within-Subjects Effects		
Deletion		df	F	Sig.
	Sphericity Assumed	1	6.262	.014*
	Greenhouse-Geisser	1.000	6.262	.014*
	Huynh-Feldt	1.000	6.262	.014*
	Lower-bound	1.000	6.262	.014*

Table 8. *Results of a pairwise comparison for deletion (* $p < 0.05$*; Std. Error 0.001)*

	At completion	In progress
At completion		0.014*
In Progress		0.014*

Table 9. *Descriptive statistics*

	Mean	Std.	DeviationN
DELETES	9.09	14.881	87
MISTAKES	326.64	236.420	87

mistakes exists. While students were asked to mail their results to their instructors, none of them was graded on their performance. However, knowing that the instructor will see the results might have encouraged some students to repeat exercises that, according to their judgment, contained too many mistakes.

Given these results, one could start speculating on learners' behaviour with respect to test pressure, self-image of learners, etc. For example, will less confident students repeat those exercises and thus delete their reports more often if the report, according to their judgment, contains too many mistakes? Further studies are certainly needed to provide insight on these speculative questions and assumptions.

5 Conclusion and further research

The current study indicates that students utilize the information contained in an inspectable learner report. Over the course of the semester, students accessed our *Report Manager* approximately 33 times. Of our learners, 70% repeated whole exercise sets after viewing their results, suggesting that learners are influenced by the information contained in an inspectable leaner report. Of the students, 16% never viewed a detailed error break-down of their performance.

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Table 10. *Pearson's correlation coefficient*

		DELETES	MISTAKES
DELETES	Pearson Correlation	1	0.194*
	Sig.		0.036
	Sum of Squares and Cross-products	19045.264	58709.851
	Covariance	221.457	682.673
	N	87	87
MISTAKES	Pearson Correlation	0.194*	1
	Sig.	0.036	
	Sum of Squares and Cross-products	58709.851	4806915.954
	Covariance	682.673	55894.372
	N	87	87

*Correlation is significant at the 0.05 level

Our data further suggest that there are significant differences in the distribution of student access of the *Report Manager* with respect to different exercise types, suggesting that the results are context-dependent. Our study shows that, for all exercise types, students delete them more often after having completed the entire set of exercises. The differences noted in deletion of exercises that are in progress as opposed to completed are more prominent with fill-in-the-blank and translation than with build-a-sentence and dictation. The time required to redo an entire exercise set may be a determining factor for students. Finally, while we did not find any learner variables that significantly influenced student access of our *Report Manager*, our study suggests a significant correlation between number of mistakes and number of deletes.

While students were not graded on the exercises, they were asked to send their results for each exercise and chapter to their instructor. It is possible that the mere fact that their results had to be submitted motivated students to repeat those exercises that, according to their judgment, contained too many mistakes. A subsequent investigation that considers further dimensions might shed more light on the question of whether grading students' assignments and/or the quantity of work undertaken are significant factors in learners repeating exercises.

We are currently expanding our *Report Manager*. The revised version will display each incorrect sentence that the student submitted and one of our goals is to investigate how learners treat the information. For example, will students still repeat entire exercise sets or only the incorrect sentences that were identified by the system? It is quite likely that we may find an increase in the overall access of our *Report Manager* because an even higher percentage of students may want to redo the subset of incorrect sentences that were identified by the system.

Finally, we are also interested in studying the effects of opening up the learner report to the scrutiny of others. Bull and Nghiem (2002), for example, state that by directly comparing their own characteristics to those of their peers, the learner may gain a greater understanding of their problems in the domain. Accordingly, it is our goal to investigate whether students indeed inspect the learner reports of their peers and how they are influenced by the information.

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