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See Yourself Write: A Simple Student Model to Make Students Think

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Abstract

This paper introduces *See Yourself Write*, a system with two components: 1. a template for tutors to provide feedback to their students on their foreign language writing, and 2. an inspectable student model which is automatically constructed for each student, based on the feedback given by the teacher. The student model holds feedback given to students across several assignments, and provides an individual evaluation of their performance. The model is designed to be viewed by the students to prompt them to reflect on, and use the feedback received.

Introduction

How much notice of feedback do students take? The answer depends partly on the particular learning situation. However, even when there is a course requirement that work must be resubmitted with tutor (or other) feedback being taken into account, it still occurs that in *subsequent* assignments students do not always look back to their earlier difficulties and their recurring problems and, indeed, their strengths.

One way to capture feedback and to cross-relate it for ease of comparison by learners is to incorporate it into an inspectable student model. Student models are usually hidden from the learner who is being modelled, and are used by a computational educational system to adapt the interaction in some way to suit the individual's needs. However, *viewable* student models have also been created, where learners are able to see the representations of their knowledge or level, that are held in the system. For example, Corbett and Anderson's (1995) skill meter in the ACT Programming Tutor displays current performance levels as a simple indicator to the student of how well s/he is progressing. Cook and Kay's (1994) um, an inspectable user model for the sam text editor, has educational benefits such as alerting users to the size of the domain, and easing the selection of what to learn within the domain. An important use of an inspectable student model is suggested by Self (1988), as *promoter of reflection*. This is also one of the reasons offered by Paiva, Self and Hartley (1995) for externalising the contents of the learner model, and one of the main benefits claimed for the Mr. Collins collaborative student model (Bull & Pain, 1995; Bull & Smith, 1995).

The above student models, although open to student viewing, are nevertheless conventional in the sense that they exist for use within computationally based educational systems (or at least, systems with educational potential as one of their aims). This is a somewhat different scenario from that of the learner model to be described in this paper. It is still expected that use of the inspectable student model presented here will lead to improvement in the student's work, but this work is not necessarily computer-based, and the student model is not updated at the same time as the work is being undertaken. It is updated after completion of each assignment, with a focus on student use of the information to aid future performance, rather than system interpretation of the representations towards some desirable form of adaptation. Because of this perspective of *a student model for the student*, the likelihood of learner disinterest in their own model as described by Barnard and Sandberg (1996) is smaller. Indeed, it has been shown that if confronted directly with representations about their

performance and misconceptions, students will often want to interact with this information (Bull & Pain, 1995). It is on this curiosity and student desire to make sure that their student model is right, that we build here.

This paper presents *See Yourself Write*, a system comprising two parts: a template through which the teacher gives students feedback on each writing assignment they complete, and an individual student model which is automatically created from the feedback provided by the teacher, and which is built up over time. The student model of *See Yourself Write* is inspectable, to promote learner reflection and to encourage learners to use the feedback received from their tutors in their future assignments. The domain is writing in a foreign language, as this is an ideal open-ended domain in which to illustrate the benefits of an approach to student modelling which is not restricted by the limitations of the ability of a system to infer the contents of a student model from some kind of student input. Further, because there is a range of aspects of feedback which may be relevant to writing assignments it is possible to demonstrate a student model which holds a variety of information types. *See Yourself Write* differs from other computational writing environments containing a learner model (such as LICE: Bowerman, 1992), because the aims differ. Since the *See Yourself Write* model is constructed from teacher feedback, the writer is not constrained in any way during his/her writing as happens, for example, in LICE. The inferencing which takes place in the construction of the model occurs away from the learner. Because the student model aims to help students think about, and take control of their learning, the qualitative textual descriptions produced by the teacher are also an important component of the model. The term ‘student model’ is therefore broader in this context than is customary, including both system evaluation and teacher feedback, and encompassing also what some may prefer to term ‘explanation’. However, since this explanation is concerned with system justification of the contents of the model, and is accessed through the model, it is here considered to be part of the student model. (See also Bull & Pain, 1995; Cook & Kay, 1994.) Similarly, the qualitative examples and explanations provided by the teacher which are not interpreted by the system, are intended to supplement and clarify to the learner the quantitative information inferred in the model.

Feedback on Writing

There have been some examinations of what students do with feedback on their foreign language writing. Cohen (1987) finds that it is often the (self-rated) poorer learners who pay little or no attention to teacher feedback. In Cohen’s study a very common strategy for dealing with feedback for all learner types was to make a mental note of the comments received. This result was repeated in a later study (Cohen & Calvacanti, 1990). Another finding of the latter study was that learners claimed to not know how to handle a high proportion of the feedback received (ranging from 21% to 81% of the comments received by individuals).

Important to the question of what students do with feedback is the issue of how useful the feedback is perceived to be, and its effectiveness in leading to improved long-term performance. Grabe and Kaplan (1996) state “responding to students’ writing can greatly influence student attitudes to writing and their motivation for future learning”. Cohen and Calvacanti (1990) found that there are sometimes discrepancies between the kind of feedback students desire, and the feedback actually offered. Fathman and Whalley (1990) found in their study that feedback on grammar errors had a greater positive influence on subsequent rewriting, than did feedback on content (though the effect here was also positive). It might therefore be useful to offer feedback on a range of issues until more is known about this¹. Another example showed that students would have liked some information about what they were doing well, in addition to the more ‘negative’ comments received (Cohen & Calvacanti, 1990).

What does this suggest for *See Yourself Write*? Clearly it will be useful to consider how to induce learners to take more account of their feedback. Consideration must also be given to ways to ensure that feedback is neither too vague nor ambiguous, and that it is actually beneficial. It should also encourage the provision of positive feedback. The following sections describe the architecture of *See Yourself Write*, and address the need for useful, usable feedback, and for attention to be given to this feedback by its recipients.

¹ In addition to helping students, *See Yourself Write* could itself be used to collect this type of information for research into this question.

See Yourself Write

Writers have varied approaches to writing, therefore *See Yourself Write* is not an attempt to prescribe any particular feature(s) of the writing process, as is sometimes found (see e.g. Salomon (1993) for a system aimed at making young composition writers plan). *See Yourself Write* is designed for older writers, and tries to make learners more aware of why they are doing well in some aspects of their writing, and why they may be having difficulties in others.

See Yourself Write has been designed initially for students writing language assignments as part of a foreign language course. Any foreign language may be the target language, and a variety of writing tasks can be used (e.g. descriptive essay, translation, factual reports, etc.), since there are a number of aspects of writing which are common and important across different types of written document. The categories currently used in the template and student model are: content coverage, structure, argumentation, style, vocabulary, spelling, grammar and punctuation. These will not all be relevant in all cases, for example content coverage will be less of an issue in translation than in a literature review. However style, for example, will tend to have importance in both. There is also a non-specified component enabling feedback to be given on a more general level about the assignment, and also to enable feedback on areas not falling into the above categories.

The aim of the *See Yourself Write* student model differs from more conventional learner models in that it is not intended as a source of information for a computational educational system, but rather, it is a source of information *for the student*. It reflects to students feedback on their own work, and information about how they are progressing and about their overall performance. Information in the student model is both qualitative and quantitative. Its main purpose is to promote learner reflection on completed assignments in such a way as to lead students to use this feedback to improve subsequent work. Thus, *See Yourself Write* is in part a vehicle through which a simple student model may be constructed by an expert teacher, without the teachers themselves needing to analyse each student's current work with respect to that learner's previous work. The teacher provides feedback manually, in a similar form to the way in which s/he would normally give feedback, and the creation of the student model is automatic: it is drawn from each of the pieces of feedback for a particular student, which have been produced to date, by the teacher.

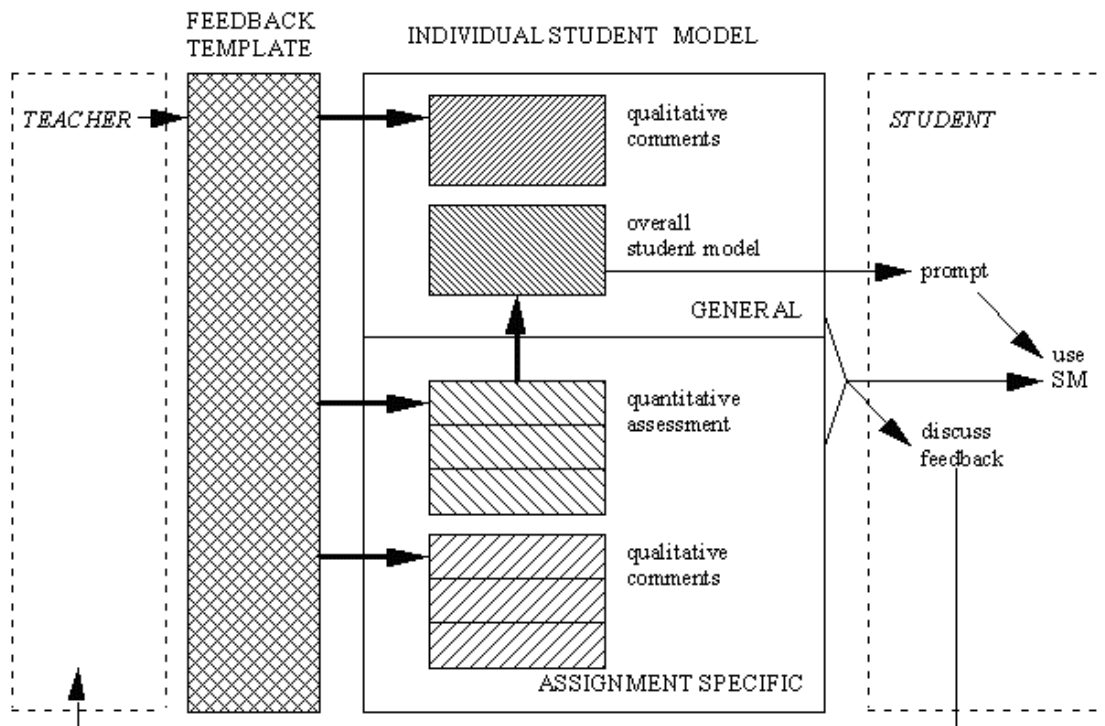


Figure 1: the architecture of *See Yourself Write*

Figure 1 illustrates the structure of *See Yourself Write*. The expert teacher provides his/her usual feedback through a template created for the particular domain and task requirements (here writing in a foreign language).

Once the feedback has been entered into the template to the teacher's satisfaction, s/he sends it to the separate student model where qualitative information is placed in the appropriate areas for student retrieval, and quantitative information is similarly distributed for ease of viewing. In addition, the quantitative feedback is evaluated by the system to provide a more 'general overview student model' to be used by the student in conjunction with feedback on individual assignments.

The student model part of *See Yourself Write*, as stated above, is constructed from the teacher's feedback. The qualitative components of the student model are illustrated in figure 1 by: //// (the closer diagonal lines depict overall or more general representations, while those with greater spacing show representations relating to a specific assignment). Quantitative representations are illustrated by the opposite pattern: \\\ (again with spacing between lines indicating the generality of the representation). Figure 1 therefore illustrates a case where so far three writing assignments have been completed by this student, both qualitative and quantitative evaluations having been provided by the teacher for each piece of work (hence the three sections to the qualitative and quantitative spaces depicted in the assignment-specific section of the student model). The quantitative component of the assignment-specific representations is used by the system on student request, to construct the representations for the quantitative overview student model in the general section. In this space there also exists a qualitative overview, drawn from general comments submitted by the teacher separate from any one particular assignment. The thicker arrows leading from the template to the student model, and within the model - between the assignment-specific and general quantitative information - portray automatic creation of representations. The thinner arrows illustrate manual feedback produced by the teacher (via the template), and interactions of the learner with the student model. These aspects are under the control of the teacher and the student respectively, though advice is also available for both students and teachers through the provision of short user manuals. This information is later also to be incorporated directly into *See Yourself Write* in the form of two help systems.

The Teacher's Template

Information is input by the teacher via edit fields in the template. *Quantitative information*, which is used by the system to determine the overall student model, is obtained through selections from alternatives offered by the system. This is to ensure that information is provided in a form which is usable by the system. Quantitative information is at present limited to a choice between (usually) three options to describe the performance of a student in different areas (e.g. for content coverage: good, okay, superficial; for punctuation: good, okay, weak, etc.) In a later version, this aspect will be amendable by the teacher to allow as many choices as appropriate for the kind of marking scheme used.

An advantage of this approach is that it encourages teachers to give positive comments in addition to feedback on areas of difficulty, since the options available range from good to weak (or similar options). The existence of explicit pre-defined categories also encourages teachers to provide information on a variety of areas. This allows a more complete student model to be created.

Qualitative information can be input into each category in whatever textual format the tutor wishes. This information is not usable by the system in its modelling of the student, but it is important for explaining problems to the student, or acknowledging what the student has done well; for giving examples of correct versions of problematic points, etc., i.e. aspects of writing for which it is hard for a computational system to provide accurate and useful feedback. The possibility of providing qualitative feedback in distinct categories has similar advantages as suggested for quantitative descriptions: positive comments; different areas of feedback, and so on.

The Inspectable Student Model

Each student receives their own individualised student model, divided into sections to represent progression over time (T1 - T3 in figure 2 below). Figure 2 is an example based on the current implementation, using Malay as the target language. In this illustration three assignments have been completed so far. The examples come from part of the information in the student model on grammar. Excerpts from other areas may look very different. The plain boxes portray information in the student model (entered by the teacher or constructed by the system). The shadowed boxes are the student's notes to him/herself and comments to the tutor. The student may open and close boxes to access and add information as s/he wishes.

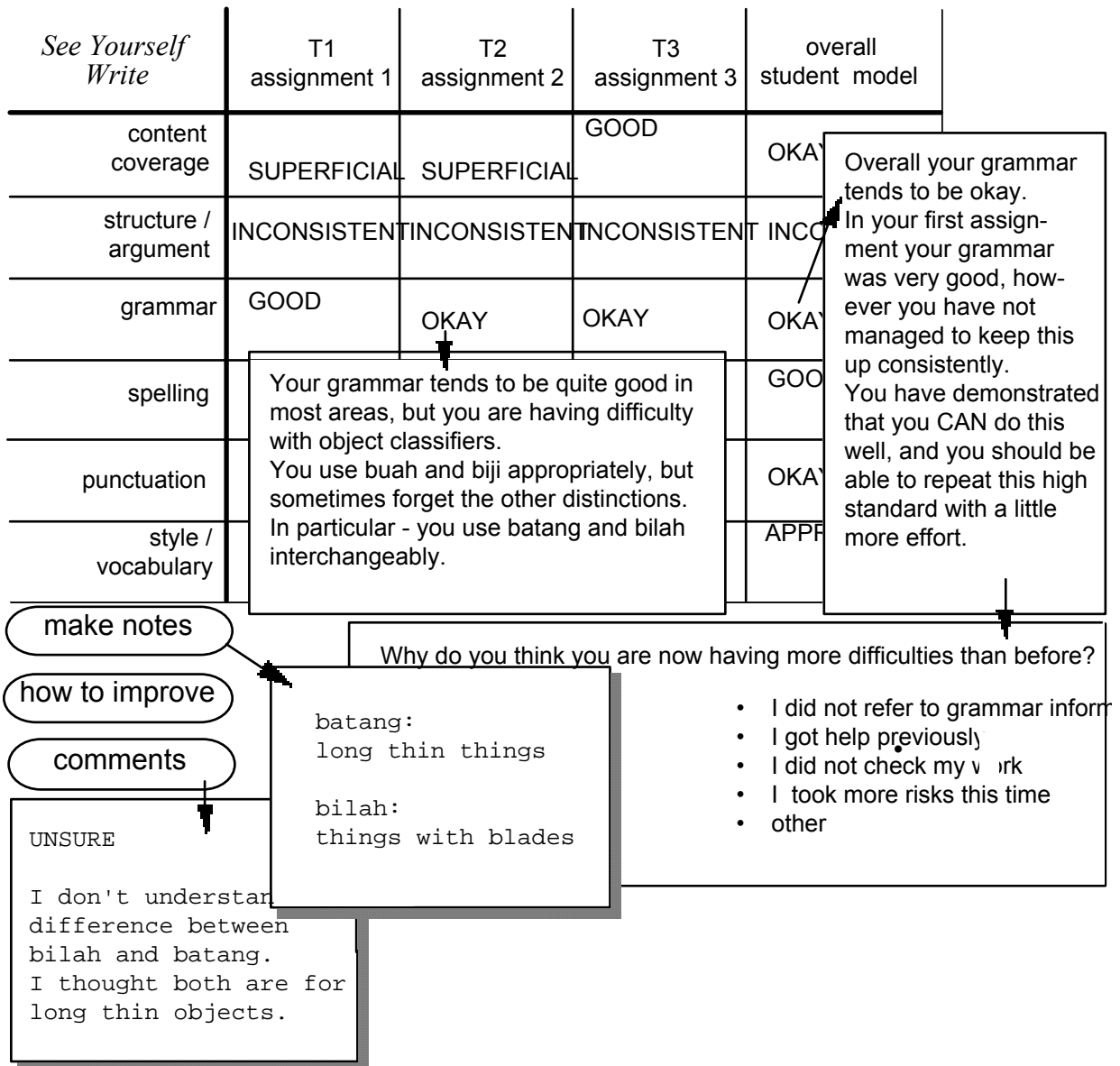


Figure 2: examples from a student model

In the current version of *See Yourself Write* the generalisation algorithms performed on teacher feedback on individual assignments to enable system construction of the underlying representations for the overall student model, are quite simple. The system ‘averages’ the teacher’s quantitative feedback for each category across each assignment completed, to calculate the values for the overall model. For example, if three assignments have been written, and the teacher has awarded ‘superficial’ in the category ‘content coverage’ for assignments 1 and 2, and ‘good’ for assignment 3, the system would assign the description ‘okay’ as the summary description for this part of the overview student model. Although all assignments for a student are taken into account by the system, greater weight is given to later ones. This is achieved by assessing assignment category values in pairs: assignment 1 with assignment 2, then the combined result of assignments 1 and 2 with assignment 3, and so on. For example:

situation after first assignment:
 category X of assignment 1 → category X of overall student model 1

situation after second assignment:
 category X of assignment 1 → category X of overall student model 2
 category X of assignment 2

situation after third assignment:

category X of overall student model 2 —> category X of overall student model 3
category X of assignment 3

Qualitative information in the overall system model (shown in figure 2 for grammar) is based on system selection of the appropriate template (which depends on the consistency of performance in a category across assignments; whether performance is improving, etc.) The details are filled out according to each of the category evaluations of successive assignments. In the example in figure 2 the system has selected a template that acknowledges that a student *can* write correctly according to the target language grammar, but recognises that this has not been done consistently. Its choice of template for this category is based on the rule:

IF student started well
AND performance decreased
THEN choose template 'good-decreasing'

The essential features of the template 'good-decreasing' are acknowledgement of:

good start;
decreasing performance;
demonstrated ability;
potential future good performance.

The details are derived from the teacher evaluations of the category in individual assignments.

A conventional student model might describe the information in figure 2 in a way able to represent the points in figure 3.

area:	grammar:	level	consistency	problems	improvement
		okay	varied: decreasing	obj. classifiers: okay - buah probability high okay - biji probability high okay - batang probability low connect: bilah okay - bilah probability low connect: batang	possible / likely

Figure 3: information in a 'conventional' student model

A traditional student model will often not keep a separate record of information gathered in earlier interactions over a longer period, but will rely on overall representations such as in figure 3. This may be sufficient in a model working towards collecting information for use for system adaptation, but it is of less direct use when aiming to make learners think about why they are achieving the results they are given. It is the students who should be doing the thinking, not the system. Differences are also found in the level of detail of qualitative descriptions, achievable through using real teacher feedback.

The student's consultation with the individualised student model of *See Yourself Write* is aimed at promoting reflection through scrutinising the contents of the model, and using this information in the composition of future work. All aspects of the student model are inspectable: qualitative and quantitative information, and assignment-specific and general information. In addition to the transparency of the student model, reflection is encouraged by two further means: system prompts about why the student believes this particular pattern of development of his/her work over time has occurred (see figure 2), and the possibility of explicitly disagreeing with the contents of the model, and relating this disagreement to the teacher for comment or further evaluation

(comments: figure 2). Students' willingness to dispute the contents of their student model to the computational learning environment has been suggested (Bull & Pain, 1996), as has the possibility of them defending themselves against a human assessor in a similar context (Pain, Bull & Brna, 1996). This kind of interaction requires justification and explanation by the student of his/her viewpoint, thereby taking advantage of self-explanation: although students using *See Yourself Write* are here really intending to explain their perspectives to another person (the teacher), the articulation of their views in a manner which is clear enough to be understood by, and submitted to the teacher, is likely to make any problems also clearer to the students themselves - indeed, possibly to the extent that they no longer wish or need to consult their teacher over representations about which they are unsure, or even with which they initially disagreed. Therefore, as well as a facility to request further clarification, this is also a 'disguised attempt' to promote self-explanation and reflection. It also overcomes the problem of getting students to self-explain in a realistic manner. They perceive the task as that of obtaining external assistance, and while this is still available if required, the very process of demanding it may result in the help originally sought becoming unnecessary.

Figure 2 showed how the student receives an overview of the way in which their performance on different aspects of the writing task has developed over time². For example, reading left to right it can be seen that although the initial coverage of content area was weak, the student in this example has subsequently improved. The overall assessment in the final column reflects this, though it remains a little cautious since the leap was so dramatic.

Students may click on individual evaluations to obtain more detailed qualitative comments from their teacher (as shown in figure 2 for grammar in the second assignment)³. An overall summary for each aspect of writing, as calculated by the system, can be obtained by clicking on options in the final summary column as shown here for grammar⁴. This should help learners identify which areas need more work. Suggestions are also available about how easy it might be for a particular student to improve a particular aspect of their writing. Prompts (determined from the overall student model) can also be requested. These are designed to help writers work out what it is about their approaches to the task that makes them successful or unsuccessful in the different aspects of the task, and to consider how they might improve. They are also encouraged to think about the reasons for improvement over time, or to consider why their level may have decreased. Their responses to the prompts are recorded for later consultation.

Clicking on the assignment numbers reveals any general comments given on that assignment. There are three further buttons: 'make notes', 'how to improve' and 'comments', and a fourth located over the *See Yourself Write* title.

Clicking on 'how to improve' displays all the information gained from all the prompts aimed at provoking metacognition, which were activated (see above). This is in the form of a student's responses to questions about how they could improve their performance, and what they have already done which has led to success.

Clicking on 'comments' results in a system request for information about whether the student in general agrees or disagrees with the contents of the model, or whether there are aspects about which s/he is unsure. After responding to this request, if appropriate an edit field appears where the writer may explain any disagreements, etc. As explained previously, this facility is aimed primarily at assisting the learner to resolve his/her own difficulties through reflection on problems, this occurring through the need to defend themselves by stating explicitly their standpoint. However if no such resolution occurs, the learner's description can still be passed to the teacher for further feedback. This is important because teachers do not always identify grammatical misconceptions correctly (Chambers, 1994). Furthermore, the writer may have deliberately strayed from the standard format in order to achieve a particular specific effect (e.g. in the structuring of their document). Students can here also request clarification of any feedback they are not sure how to handle, or may request elaboration or comment on areas not represented in the feedback. In the example in figure 2, from the student's notes it can be seen that since writing a comment to the teacher about the difference in use of 'batang' and 'bilah', s/he has realised the distinction (and will now no longer need to ask the teacher for clarification).

² The student model appears initially to the writer in a similar form to the main background area in figure 2. The textual descriptions in figure 2 have been reduced in size and detail, to allow several examples to be legibly included in the one diagram.

³ Teachers are also requested to list areas of difficulty so that the system and students can easily compare points (e.g. tense, affixation, etc.)

⁴ For convenience of illustration the description has been shortened.

The writer may write notes on any of the information contained in the student model by clicking on 'make notes'. Students are thereby encouraged to interact with their feedback. They may write, or copy and paste information into the notes field in order that they may later easily locate points to which they wish to refer when writing their next document. Because of this noting facility students are likely to make more than just a mental note⁵, and are also more likely to consult this information when attempting a new assignment. The student's notes may be printed.

By clicking on '*See Yourself Write*', writers obtain an area into which they may type any corrections or explanations that the tutor has requested. This is an additional way in which writers can be encouraged to take account of their feedback: when this facility is used, since the request will have come from the teacher, there is some expectation on the part of both the student and the teacher that the student will take account of what has been said, and provide a response. This response will be available to the teacher when s/he updates the student model after receiving the next assignment.

A Student-Teacher Interaction

Detailed evaluative results are not yet available. However, initial indications (from a questionnaire) suggest that most students will find *See Yourself Write* useful. (Two thirds of respondents answered 'useful' or 'very useful'.) Those who were not enthusiastic stated that they would prefer to discuss their feedback face-to-face with the teacher. However, it should be noted that *See Yourself Write* is designed to be used in place of written feedback produced in the more usual linear form. There was no reduction in the time available for individual face-to-face contact between the tutor and students.

The following comment illustrates the views of learners who found the system useful:

"The feedback on assignments highlighted my weaknesses. I knew where they were but without the feedback I would never have investigated them further or have tried to correct them."

In order to illustrate the way in which *See Yourself Write* has been used to date, the following is an extract from a student-teacher interaction about the student's essay on the subject of tourism and the environment. (Part of the student essay to which the feedback and discussion refers, is given in the appendix.)

Teacher feedback:

STRUCTURE/ARGUMENT: INCONSISTENT

A number of illogicalities:

1. Surely to make your point, you need to argue that expansion of tourism has led to excessive development of transport systems?
2. What is the relevance of whaling to tourism?
Are you seriously suggesting that tourists' appetite for whale-meat has endangered the species?

Student response:

1. Yes, but it also works the other way around in that transport systems have allowed tourism to spread to more remote parts of the world.
2. Yes, I suppose I have been a bit over the top! But if whale meat wasn't considered a delicacy in certain countries it's doubtful they would have to be killed at all.

Teacher response:

1. Yes, that's fine. But in your essay you've first said that transport has developed, then further suggested that tourism was the cause of people wanting to travel - rather than the means of travelling (i.e. transport) leading to more tourism. The organisation of your ideas is confusing.
2. But you need to integrate this point more explicitly into the topic of the essay, which was tourism and the environment.

⁵ Sometimes this can be sufficient, but often it is not.

Teacher feedback:

GRAMMAR: GOOD

generally good, but please give correct preposition after the following:

- il est nécessaire
- il est important
- penser
- beaucoup

Student response:

il est nécessaire + de
 il est important + de
 penser + a
 beaucoup + de

In the above interaction the student was eager to provide information on her point of view if this appeared to conflict with the feedback she had received. This can be seen under 1 of the category 'structure/argument', where she challenged the teacher's interpretation of her point. In response the teacher explained that although there was no problem with what she had intended to say, this was not, in fact, what she had claimed in her essay. This interaction clarified to the teacher what was actually intended, and to the student that it was not the content of her argument that was at fault, but that the organisation of the argument was misleading. Without this interaction with feedback it is less likely that the misunderstanding would have been uncovered. The teacher also requested corrections where she felt these necessary. Since such requests appear to be a task set for the student, the student responds (see category 'grammar').

As stated above, the extent to which students interacted with *See Yourself Write* varied. Some did very little (though not less than they would have done had the feedback been in another form), and some worked intensively with their feedback, and gave detailed reactions to the information in *See Yourself Write*. It is encouraging to note that some would discuss the feedback in depth through the *See Yourself Write* system, in a way which did not occur feedback was given in a more conventional form.

Summary and Conclusion

See Yourself Write is aimed at helping learners to reflect on their performance, and to think about how they might improve their work by:

- viewing and interacting with a student model based on teacher feedback;
- making it easy for students to access useful comments on earlier work when composing a new piece of work;
- being prompted to explain how they could improve, or to give reasons to explain their improvement/deterioration, etc.;
- being encouraged to take advantage of self-explanation of difficulties by disguising this as a request for outside assistance.

The domain is one in which it is difficult to get useful feedback computationally. *See Yourself Write* combines the use of teacher feedback - provided in a way which suits the teacher - and the advantages of an inspectable student model, to promote reflection. The facility for learners to disagree with the model also enables teachers to become aware of their mis-diagnoses. The system-generated component is necessarily quite simple as this enables tutors to give the kind of feedback they consider most useful. However, the inclusion of system-generated representations in *See Yourself Write* allows the system to be more than a 'giver of feedback' without requiring additional analyses from teachers. It also encourages teachers to provide feedback on a range of aspects of the task, positive as well as more critical. Although the quantitative representations forming the 'more usual' aspects of the student model are limited, the qualitative components can be as detailed as the teacher wishes.

Remaining questions include: is a more fine-grained quantitative analysis desirable? Would a more graphically oriented interface be useful? Should some of the 'free information' provided by teachers be analysed, or would this be too restrictive?

Acknowledgement

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