Individualised Recommendations for Learning Strategy Use

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Abstract. This paper describes LS-LS: a system to raise awareness of language learning strategies to help students become more effective learners. The focus is the student model, which contains representations of learning style and current strategy use: information provided explicitly by the learner. LS-LS infers additional strategies of potential interest to an individual, based on the contents of their student model. It also suggests computational learning environments that a student might find useful to practise these new strategies, based on information provided by the (human) tutor about locally available software.

1 Introduction

Linton observes that intelligent tutoring systems (ITS) are often judged by their ability to make tutoring decisions for the learner, despite the fact that self-directed learners actually possess a valuable skill [1]. Learner autonomy is also important in foreign language learning [2]. Much research has indicated that appropriate use of language learning strategies can contribute to autonomy and success in learning a second language [3]. There are various definitions of language learning strategies: some relate to conscious application of techniques to help a learner [4]; others allow the possibility of unconscious strategy use [5]. Kohonen states learners can be made aware of their strategy use, and that they may modify it with 'conscious effort' [5].

Early work suggested there are successful language learning strategies, and teaching these strategies to less successful students might help them improve their performance [6]. Later research found some unsuccessful learners actually use many of the same strategies as more successful peers [7]. Such students need to learn how to apply strategies *appropriately*. Further, it is not the case that all good learners use the same strategies [8]. Strategy choice may depend to some extent on learning style [9]. It seems that while tailored application of learning strategies is useful, there is no single set of strategies appropriate for recommendation to all learners [10]. Indeed, Oxford recommends "strategy training should be somewhat individualized" [3]. However, this is difficult in the typical language learning situation, where there is a single teacher working with a foreign language class, for a limited time period.

A few tutoring systems encouraging the use of a variety of language learning strategies have been implemented [11,12], to foster the kind of self-direction proposed by Linton [1] for an ITS. Nevertheless, these systems are tied to their own contexts.

G. Gauthier, C. Frasson & K. VanLehn (eds), Intelligent Tutoring Systems,
Springer-Verlag, Berlin Heidelberg, 2000, 594-603.

Implementation of a more widely applicable system to foster the acquisition of language learning strategies has also been undertaken [13]. However, this requires expensive hardware often not available in student Language Centres.

This paper introduces LS-LS (learning style–learning strategies): an environment to raise student awareness of language learning strategies, to help them become more autonomous learners. LS-LS recommends potentially useful additional strategies to an individual, according to their learning style and current strategy use, and suggests ways students may practise these new strategies. It is designed primarily for use in contexts where resources are restricted, and where individualised, teacher-led strategy training programmes are infeasible. LS-LS runs on most Macintosh computers.

LS-LS is centred around a student model constructed with the help of explicit student contributions, following a recent trend in student modelling [14-19]. In addition to providing information for the student model, in LS-LS this approach has the function of promoting learner reflection on both the student's own specific approaches to learning, and on different ways of learning in general. Thus, even before receiving strategy suggestions, students are thinking about their learning.

LS-LS is unusual in the sense that the student model is not part of a larger tutoring system. The suggestions made by LS-LS refer in the main to activities *outside* the LS-LS system. Some of these recommendations will include suggestions for computer-based interaction to practise strategy application. This requires some additional information about the local situation, which must be provided by the teacher.

2 Theoretical Basis of LS-LS

LS-LS aims to help learners become more self-directed by introducing new learning strategies which fit with their learning style and current strategy use. These two types of information form the student model. The initial representations are provided directly by the student, by indicating which aspects of learning style descriptions are applicable to their own learning, and which learning strategy descriptions apply.

Various learning style inventories have been developed [20-22]. That used in LS-LS is adapted from the *Myers-Briggs Type Indicator* (MBTI) [22], as the MBTI was found to correlate with students' choice of language learning strategies [9]. The MBTI is based on Jung's theory of psychological types [23]. It describes people in terms of four characteristics: introversion/extraversion; sensing/intuitive; thinking/feeling; perceptive/judging. However, the MBTI questionnaire is extensive, and in the context of LS-LS learners may not be prepared to spend much time. Therefore a much simplified adaptation is used, whereby students select amongst brief descriptions of learning style components [24]. To compensate for the lack of detail, students may indicate that two poles (e.g. thinking/feeling) are both applicable. This results in a less precise learning style descriptor, but it does ensure that students are not forced into providing information about which they are unsure. Indeed, lack of preference in any of the four descriptor pairs is not necessarily negative. It may indicate that the student does not lie at either extreme of the continuum: their individual learning style may encompass both aspects of the paired descriptors. Allowing this possibility in LS-LS

ensures that potentially useful learning strategy suggestions are not suppressed by the system as a result of forced selection of one aspect of learning style over another.

The language learning strategy classification system used in LS-LS is adapted from Oxford's *Strategy Inventory for Language Learning* (SILL) [25]. The SILL has been used extensively by researchers, and has been found to have high validity, reliability and utility [26]. It is administered to students as a questionnaire, and measures the frequency with which a student uses *memory*, *cognitive*, *compensation*, *metacognitive*, *affective* and *social* language learning strategies, giving the result: low, medium or high use, for each category. As with learning style, in LS-LS students identify their current strategy use from short strategy descriptions. As results have shown, information about individuals' use of strategies from different strategy classes can be very useful for research purposes. However, this kind of information is less meaningful to learners. For example, what does it mean to a student to be told that they have 'a medium use of compensation strategies'? Thus LS-LS requires additional information to be overlaid on Oxford's classification scheme. This is provided by a *Strategy Similarity Measure* (based on [11]). This similarity measure is a theoretical construct indicating conceptual similarities amongst strategies. This allows new strategies to be introduced with reference to strategies already used, so suggestions are more meaningful to learners. It also enables strategies to be considered individually, rather than only in the six strategy groups identified by Oxford.

This approach requires learners to be able to identify their current strategy use, as LS-LS obtains initial representations by self-report. A previous study found adults were indeed able to identify their strategy use in a manner similar to that used to acquire the LS-LS student model. Furthermore, most were interested in doing so [27].

In summary, LS-LS is based on four areas of previous research:

- learning strategy classification [25];
- the ability of students to identify their learning strategy use through self-report in a computational environment [27];
- relationships between learning style and strategy choice [9];
- conceptual similarities between learning strategies [11].

The first area concerns the representations for the student model. The second relates to the method of obtaining this information. Points 3 and 4 form the knowledge base: representations used by LS-LS to infer appropriate strategies to recommend to an individual, according to the contents of their student model.

3 Individualised Suggestions of Learning Strategies

As stated above, to build the LS-LS student model learners provide information about their learning style and currently used learning strategies. This is accomplished by viewing descriptions (for an example see part 3 of Figure 1), and selecting the options which apply. The resulting contents for the student model are illustrated in Table 1.

Table 1 shows the student model of an adult male Mainland Chinese learner of English (advanced level), studying English in the U.K. This is presented in full to illustrate a plausible range of learning strategies an individual may use, and the kinds

of strategy that might be suggested to others. This includes 26 of the 62 strategies in Oxford's classification [25]. The student model representations are in Prolog:

learning_style([Style_Components]).
learning_style([extravert, sensing, thinking, perceptive]).
learning_strategies(Strategy_Group, [Strategy_List]).
learning_strategies(cognitive, [skimming, analysing_expressions, translation, notes]).

It can be seen that the student model is quite straightforward, both in terms of its contents and, as discussed above, in the model acquisition process.

Table 1. Representations in the LS-LS student model

Learning Style	Strategy Group	Strategy Name
extravert sensing thinking perceptive	cognitive	skimming, analysing expressions, translation, notes.
	metacognitive	overviewing/linking with known, delaying speech to focus on listening, setting goals, planning, seeking practice opportunities, self-monitoring, self-evaluation.
	memory	grouping information, associating/elaborating, structured reviewing, mechanical techniques.
	compensation	using linguistic cues, language switching, getting help, circumlocution/synonyms.
	social	requesting correction, cooperation with peers, cultural understanding, awareness of others' feelings.
	affective	using relaxation/deep breathing/meditation, using music to relax, using a checklist about feelings.

Once representations for the student model are completed, students may receive suggestions of additional strategies that may be useful. Suggested strategies must fulfil two conditions: (1) they may not conflict with the student's learning style; (2) they must have something in common with at least one used strategy. The former is based on Ehrman and Oxford's finding that learning style appears to influence strategy choice [9]. LS-LS therefore contains representations of permitted learning style–learning strategy links. For example, an ISTJ (Introvert, Sensing, Thinking, Judging) learner will be primarily recommended strategies from the groups metacognitive, cognitive and memory. This is because Ehrman and Oxford's data suggested Introverts and Thinkers are generally uncomfortable with social strategies; Sensers and Judgers disliked compensation strategies; Introverts did not like affective strategies. On the positive side: Introverts were very much in favour of metacognitive strategies; Sensers liked cognitive, metacognitive, and in particular, memory strategies; Thinkers were very positive about cognitive strategies, and also liked metacognitive strategies; Judgers liked social, and especially metacognitive strategies.

Point 2 above fulfils the requirement that strategy recommendations be made with reference to something the learner can readily understand. This is accomplished through a database of strategy links based on the *strategy similarity measure*. Table 2 shows excerpts from the database of strategy links in three of the six strategy groups. The first two examples of Table 2 indicate that there is some similarity between the concepts of the memory strategies *representing sounds in memory* and *imagery*. Thus, a student who uses one of these strategies but not the other, will probably appreciate the potential utility of the new strategy due to the similarity of the function of the pair.

The next two entries in Table 2, *analysing expressions* and *contrastive analysis,* show a similar bidirectional relationship, but in the cognitive group. The fifth entry, also concerning cognitive strategies, illustrates how the suggestion of a new strategy may be based on more than one currently used strategy. If a student uses *contrastive analysis* and *deduction*, but not *analysing expressions*, the latter will be suggested with reference to both *contrastive analysis* and *deduction* (assuming there are no objections from the learning style component). The link between *deduction* and *analysing expressions* is also bidirectional, as indicated by entry number 6, as is the link between *contrastive analysis* and *deduction* (not shown).

Table 2. Excerpt from database of strategy links

Used Strategy	Strategy Suggestion
mem: representing sounds in memory	mem: imagery
mem: imagery	mem: representing sounds in memory
cog: analysing expressions	cog: contrastive analysis
cog: contrastive analysis	cog: analysing expressions
cog: deduction	cog: analysing expressions
cog: analysing expressions	cog: deduction
cog: making notes	mem: grouping
comp: avoiding communication	comp: selecting the topic
comp: avoiding communication	comp: adjusting the message

The next entry illustrates that links, and hence recommendations, occur not only between strategies within a strategy group, but also occur *across* groups. *Making notes* is a common cognitive strategy. However, some students do not organise their notes effectively. For such learners, the memory strategy *grouping* may be suggested.

The last two entries show that a single strategy may be used as support for recommending more than one new strategy. This example also illustrates that links are not always bidirectional. Some students *avoid communication*, a compensation strategy, when a topic is problematic. Alternatives may be suggested, e.g. *selecting the topic* or *adjusting the message*. However, the reverse does not occur: a student who uses one or both of these will not receive the suggestion to *avoid communication*.

1 You already use *visual imagery* to help you remember vocabulary. There may be times when imagery is difficult. This might occur, for example, when you need to learn abstract words.
2 You may find using *sound* a good substitute for imagery, as these strategies have the same function of using the senses to learn vocabulary. They are both memory strategies.
3 *Representing sounds in memory* involves creating an association between new and known material by using sound. For example, there may be a word in your native language that sounds similar to the new word you are trying to remember. Or the new word may sound similar to another word that you already know in the target language.

Fig. 1. Example of a strategy recommendation

Figure 1 illustrates a strategy recommendation (generated from templates). It first refers to a strategy the student already uses. It then links this to the new strategy. Finally, the new strategy is described. Note that there is no implication that the suggested strategy should *replace* any strategy already used. It is simply stated that it might be a useful strategy when it is difficult to use an existing one. It is up to the

learner to decide whether the new strategy is, in fact, more helpful than any they currently apply in a particular situation.

It may be that a new strategy is not suitable: it will not always hold that a visual learner will benefit from *sound* to the extent other learners might. Hence words like 'might' and 'may' in the recommendation. However, recall only those strategies which do not conflict with learning style pass the 'strategy suggestion threshold'.

Once new strategies have been experienced, the learner may return to LS-LS for further suggestions, which can take recently acquired strategies into account.

4 Recommending Computer-Based Environments

Thus far discussion has centred on the first set of suggestions received by students: general recommendations which may be applicable to a variety of language learning contexts. The second set of proposals concerns these new strategies, but includes suggestions of specific computer assisted language learning (CALL) software available *at their institution*, where some of these strategies can be practised.

Jones explains how the institutional context is a major factor in the design of the majority of CALL programs [28]:

> *Most CALL programs are developed at universities… CALL software is usually intended for a particular course at a particular institution with a particular sort of student with particular needs. This exact matching of needs is what makes computer-based courseware so successful for its intended audience, but which can impair its marketability.* [28]

This implies that LS-LS would be severely restricting its applicability if it were not to take into account potentially numerous in-house developments when suggesting CALL activities for a student. Because much of the courseware may have been developed by language teachers, in many situations this will not include intelligent CALL. Nevertheless, because of its design focus on local students, and its recommendation by LS-LS to students because of the potential for them to practise the application of learning strategies which are *appropriate for them*, any lack of individualisation in the CALL software will be less crucial. The 'intelligence' in this approach is found in LS-LS's inferring suitable programs to recommend, depending on characteristics (learning style and current strategy use) of the individual learner.

Including local information requires input from the local tutor. It must be assumed that the tutor is aware of the CALL options available at their institution as, indeed, a good teacher should be. However, it is not assumed that tutors will already be aware of Oxford's language learning strategy classification system: they may learn about these strategies by reviewing the strategy descriptions in LS-LS (as does the student). Figure 2 shows how tutors provide information about available CALL opportunities. This method of inputting information covers a range of CALL types: e.g. concordancers (cognitive–*recognising forms and patterns, analysing expressions, contrastive analysis, deductive reasoning, resourcing*); traditional drills (cognitive–*repetition, recognising forms and patterns, deductive reasoning*); foreign language chat rooms (cognitive–*practising naturalistically*; compensation–*selecting the topic, adjusting the message, coining words, circumlocution/synonyms*; metacognitive–*seeking practice*; affective–*risk-taking*; social–*cooperation*). It can be seen that for a

single strategy, there might be several different kinds of program that may be used to experience it. Therefore learners will often be able to select the kind of software they prefer, or use more than one type of CALL to consolidate the use of their new skill.

Strategies expected to be useful in many implementations are listed for two reasons: (1) to make it easy for teachers to input required information; and (2) to encourage tutors to consider the applicability of the most likely strategies (i.e. not overlook them). Further strategies may be entered if the local situation encompasses them. Space is also available to describe *how* learning strategies may be applied. Specific instances of CALL can also be referred to. Recommendations of CALL environments are presented to students exactly as described by the tutor: the relevant strategies are listed, followed by the teacher's textual description. A few examples of CALL programs are given below, to demonstrate the value of this practice facility.

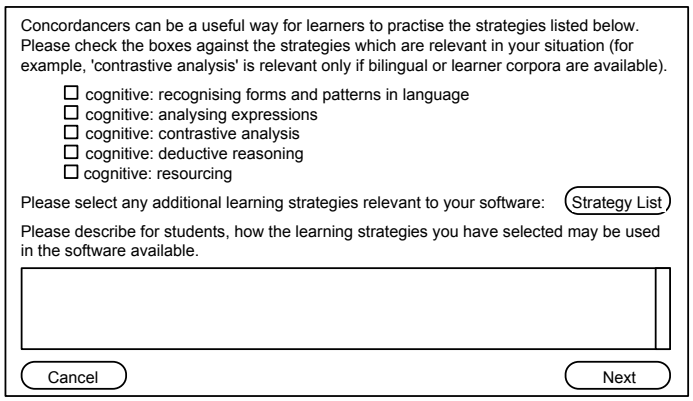

Fig. 2. Tutor input of information about available CALL options

Milton's Electronic Learning and Production Environment aims to help students write appropriately by using a concordancer together with error recognition tasks, a hypertext grammar and databases of underused phrases [29]. Thus it has the potential of encouraging the above-mentioned strategies connected with concordancing, but the *resourcing* and *deduction* opportunities are broader than with many concordancers.

In the context of translation, Metatext is a HyperCard development which has links from the main card containing the source text to datacards where learners may view or send information [30]. Therefore, in addition to improving translation skills, it can be used to explicitly practise the cognitive strategies of *noting* and *resourcing*; and the memory strategies of *grouping* and *using mechanical techniques*.

Sawada et al describe a system with which students may practise writing Japanese Kanji characters and phrases [31]. They can also test their sequencing of strokes in a character, to help them understand the structure of Kanji patterns. Thus learners may extensively practise the cognitive strategy of *formally practising with writing systems*.

Some ITSs contain a model of the target language rules, and also the equivalent rules from a learner's native language, allowing explicit reference to both languages during an interaction [32-35]. Such systems provide opportunities for learners to consider the cognitive strategies of *contrastive analysis* and *language transfer*.

Despite the potential for students to practise a variety of strategies in CALL environments, it is clear they may need guidance on how this might be accomplished– although systems have been designed to foster such skills, they are for the most part not designed with the aim of explicitly tutoring the strategies concerned. Chapelle and Mizuno recognize that much CALL assumes learners are already able to regulate their learning effectively, whereas, in fact, they often do not use the most appropriate strategies [36]. Hence the importance of allowing tutors the space to describe for students, the use of these strategies in the particular CALL contexts (see Figure 2). An advantage students who have used LS-LS might have when using these CALL systems, is that they are by then already aware of the variety of strategies that exist.

Using the student from Table 1, the learner was identified as having the personality attributes ESTP (Extravert, Sensing, Thinking, Perceptive). The rules for generating the sequence of strategy presentations for student selection of used strategies are based on these attributes. Mapping personality attributes to the strategy presentation sequence ensures that learners identify first the strategies they are most likely to use, in case they choose not to complete the full sequence of strategy identification. In our example, cognitive strategies were presented first, as the style components STP each view cognitive strategies positively (and E is neutral) [9]. Second came metacognitive strategies, typically viewed positively by EST, but negatively by P, and so on.

Strategy suggestions were presented, ranked according to personality attributes and strategy similarity measure. In our example, *contrastive analysis* was recommended early, because of the personality component Perceptive, and the used strategies *requesting correction, using linguistic clues, translation* and *analysing expressions*. In contrast, *repetition* was suggested based only on the descriptor Sensing, and came last. This recommendation according to constraints imposed by learning style and the strategy similarity measure, and the ranking of suggestions, ensures that strategies are presented in a sequence reflecting understandability and relevance for the individual.

CALL programs are then suggested, which also fit the constraints of learning style and the strategy similarity measure. These are similarly ranked according to expected utility. For our learner, a bilingual concordancer might be useful, since it allows practice of *contrastive analysis* (a strongly suggested strategy) and also *deduction* (recommended based on one personality attribute and two used strategies). Lower on the list come drills to practise *deduction* and *repetition*. The range of strategy suggestions, and hence CALL suggestions, are likely to vary since even in a small sample of students (5), total suggested strategies ranged from 6 to 16 [24].

An interesting situation has occurred, whereby an intelligent learning environment (LS-LS) will be recommending largely 'unintelligent' programs to students. LS-LS starts from a quite simple student model, performing some complex inferencing [24], to then recommending less adaptive systems. Although these less flexible programs are often criticised for their inability to take into account learner differences, when recommended by LS-LS, such differences have already been catered for.

5 Summary

LS-LS aims to raise student awareness of ways to make their learning more effective, by fostering learner autonomy in a manner that suits their learning style, and is easily understandable according to their current strategies. This occurs as in Figure 3.

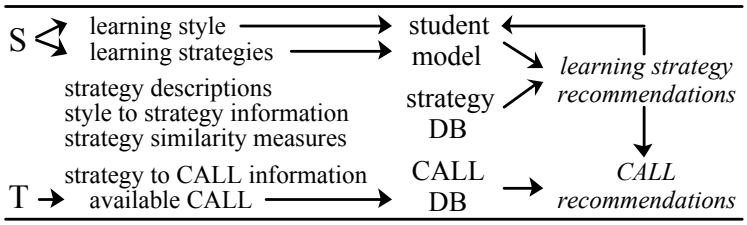

Fig. 3. CALL recommendations

LS-LS prompts students for information about their learning style and approaches to learning, offering descriptions from which they select those aspects they believe apply to their learning. The resulting representations form the two components of the student model. LS-LS also contains a learning strategy database: one part containing strategy descriptions; a second detailing information about strategies typically liked and disliked by learners with different learning styles; a third measuring similarities between pairs of strategies. LS-LS compares information from the student model to the constraints implied in the strategy database (parts 2 and 3), and makes recommendations of potentially helpful strategies to an individual. These recommendations are general: they describe strategies, with examples, but no specific learning materials are suggested. Strategy suggestions are fed back into the student model to be used should the learner later return for a further interaction with LS-LS.

A second database contains representations relating to other CALL systems. This has two parts: a general one detailing kinds of CALL program that can be used to experience different learning strategies; and a specific part describing software available locally. This second part is input by the tutor. LS-LS combines information about strategies it suggested with information in the CALL database, to suggest specific CALL programs a learner might access to try out recommended strategies.

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