PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G09B 7/04, 5/06, 19/04

A1

(11) International Publication Number: **WO 00/14700**

(43) International Publication Date: 16 March 2000 (16.03.00)

(21) International Application Number: PCT/US99/20379

(22) International Filing Date: 3 September 1999 (03.09.99)

(30) Priority Data:
60/099,245 4 September 1998 (04.09.98) US

(71) Applicant: N.V. DE WILDE CBT [BE/BE]; Ottergemsesteenweg 703, B–9000 Gent (BE).

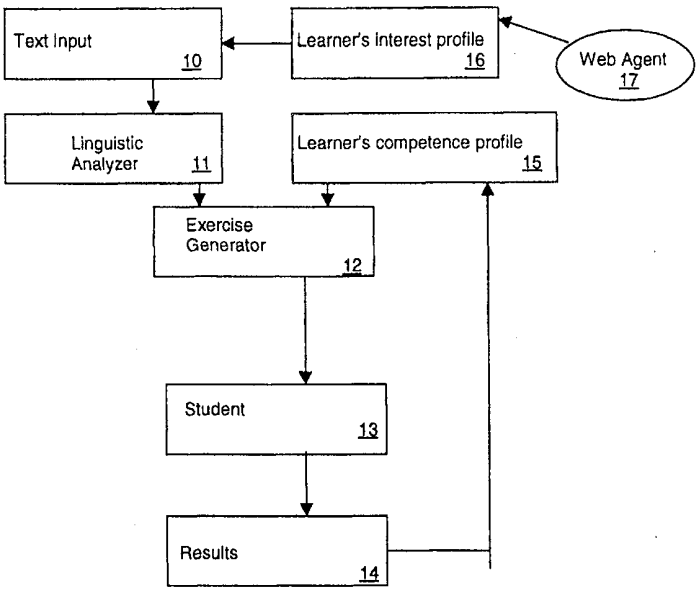
(72) Inventor: DE WILDE, Christian; Park Ter Kouter 18, B–9070 Heusden (BE).

(74) Agents: SUNSTEIN, Bruce, D. et al.; Bromberg & Sunstein LLP, 125 Summer Street, Boston, MA 02110–1618 (US).

(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: APPARATUS AND METHOD FOR PERSONALIZED LANGUAGE EXERCISE GENERATION



(57) Abstract

A system for generating personalized language exercises includes a text input (10), a linguistic analyzer (11), an exercise generator (12) and a learner's profile database (15, 16). The linguistic analyzer may perform morphological and syntactic analysis on the input text to identify linguistic data. The learners'interest profile (16) contains information relating to the linguistic competence of the users of the system in the target language. The exercise generator (12) generates language exercises using the linguistic data identified by linguistic analyzer (11) and the linguistic competence information of the user(s).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Apparatus and Method for Personalized Language Exercise Generation

Technical Field

The present invention relates to computerized learning assistance and particularly to computer-related devices and methods for assisting language learning.

Background Art

Different computer assisted language learning programs already exist. They may generally be classified either as "authoring systems" or as "closed systems". An "authoring system" is a program in which a language teacher has the full freedom to create exercises for a specific learner or a group of learners. Such a program allows a learner or group of learners to work on any given topic or text as well as on various language skills. Generally, authoring systems are designed to be used for various domains in education and training such as history, geography, etc., hence, they do not contain linguistic features or "intelligence". Thus, authoring systems require the teacher to put in the entire content and structure of the exercises manually. Teachers must type in the text, define the exercise procedure, create the exercises and anticipate the student's answers by providing possible feedback. In other words, while authoring systems allow plenty of freedom in the creation of exercises, they also require a lot of effort from the teacher. Authoring systems are extremely laborious and time-consuming.

A "closed system," on the other hand, reduces the time and effort required of the teacher. In a closed system the entire content, i.e. the texts and the exercises, are already contained within the system. The full content of this type of program is thus readily available but fixed. Consequently, the teacher and student are limited to the texts and exercises available in the system. In addition, the presented exercises are identical for every learner. This severely limits the possibilities of use because such a program may only correspond to the very specific needs of a particular learner or a group of learners by coincidence. Even when the exercises do correspond to the specific needs of a particular learner, the exercises will tend to be boring after a

certain amount of time. A particular learner will generally only repeat the same exercise for a limited number of times. Therefore the usage of this type of program is limited, both with respect to content and to lifetime.

Another type of language learning program is an "open language" learning system such as the "P.A.R.A.D.I.S.E" program, available from N.V. De Wilde CBT, Ottergemsesteenweg 703, B-9000 Gent, Belgium, holder of rights to the present invention. P.A.R.A.D.I.S.E. enables a language teacher to import any text (hence the definition "open system") and create various exercises on that freely chosen text. Exercises are based on a number of static criteria such as word category, word derivation, position in the text, frequency list, word list, etc. By making a selection from the available criteria, exercises can be oriented towards a specific learner or group of learners. However, these exercises will seldom perfectly match the learners' actual, specific needs and will certainly not take into account the learners' progress.

A second limitation of the existing P.A.R.A.D.I.S.E. program is the way in which the text is linguistically analyzed. The present programs analysis is limited to a morphologic reduction of the text words and is thus limited to analysis at the word level. Analyzing the word only on its own can cause ambiguity because it is possible for a certain word form, considered on its own, to have different interpretations. For instance, one and the same word form can be a noun or a verb. The correct interpretation cannot be deduced from the morphological analysis alone.

Compared to the above described "authoring" and "closed" systems, the advantage of an "open authoring system", such as the P.A.R.A.D.I.S.E. program is that the exercises can be generated by the teacher in a short lapse of time, on any text and with little effort.

Summary of the Invention

In a first embodiment, the invention provides a system for personalized language exercise generation. The system has

1. a text input for receiving a selected text;

2. a linguistic analyzer coupled to the text input for analyzing the selected text;

3. an exercise generator coupled to the linguistic analyzer for generating a language exercise from the selected text; and

4. a learner's profile database, coupled to the exercise generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learner's profile database. The selected text may be any text that is desired by the user or an instructor as a source from which the exercise may be generated. The linguistic analyzer may advantageously include a morphology analyzer and a syntax analyzer. In a further embodiment, the system also includes a learner's interest database, coupled to the text input, in such a manner that the selected text is related to the interests of the user. The learner's interest profile can contain positive (interested in) and negative (not interested in, or forbidden sites) information. In a preferred embodiment, the learner's interest profile may be coupled to a Web agent. The Web agent searches the Internet for interesting texts.

In a further embodiment, the system also includes a scoring arrangement for scoring the results of use of the exercise and for updating the learner's profile database based on the performance of a user in doing the exercise. The learner's profile database may include profile data for a non-null set of learners. The profile data may include parameters characterizing, for each learner in the set, such learner's linguistic competence. In implementing this embodiment, the profile data may usefully include parameters separately characterizing one or more items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

In another embodiment a method for generating a personalized

language exercise includes:

1. receiving a selected text at a text input;

2. linguistically analyzing the selected text to produce analytical data;

3. retrieving user data from a learner's profile database, stored in a digital storage medium, pertinent to a user; and

4. generating an exercise based on the selected text, the analytical data, and the user data. In linguistically analyzing the selected text it is advantageous to analyze both the morphology and the syntax of the text.

In a further embodiment, the method includes retrieving user interest data from a learner's interest database, stored in a digital storage medium, pertinent to a user, and selecting a text, in such a manner that the selected text is related to the interests of the user.

In a further related embodiment, the method includes scoring the results of use of the exercise and updating the learner's profile database based on the performance of the user in doing the exercise. The learner's profile database may include profile data for a non-null set of learners. The profile data may include parameters characterizing, for each learner in the set, such learner's linguistic competence. In implementing this embodiment, the profile data may usefully include parameters separately characterizing one or more items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

In another set of embodiments, a system for personalized language exercise generation has:

1. a language exercise database;

2. an exercise generator coupled to the language exercise database, the exercise generator for selecting a language exercise from the database; and

3. a learner's profile database, coupled to the exercise

generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learners' profile database. The exercise may be selected based on the theme of the text, the type of exercise or another parameter contained in the exercise.

In another set of embodiments, the invention provides a digital storage medium digitally encoded with instructions, which when loaded into a computer establish any of the systems described above for personal language exercise generation.

In yet another embodiment, a method for generating a personalized language exercise includes:

1. retrieving language exercises from a language exercise database;

2. retrieving user data from a learner's profile database, stored in a digital storage medium, pertinent to a user; and

3. selecting a language exercise from the language exercise database based on the user data.

Brief Description of the Drawings

The foregoing features of the invention will be more readily understood by reference to the following detailed description, taken with the accompanying drawings, in which:

Fig. 1 is a block diagram illustrating a system for personalized language exercise generation in accordance with a preferred embodiment of the invention.

Fig. 2A is a block diagram illustrating the morphologic analysis of text in accordance with the system of Figure 1.

Fig. 2B is a block diagram illustrating the syntactic analysis of text in accordance with the system of Figure 1.

Fig. 3 is a table identifying parameter characteristics associated with the learners' competence profile of the system in Figure 1 in accordance with a

preferred embodiment of the invention.

Fig. 4 is a table setting forth, with respect to the embodiment of Figure 1, user preferences available in transforming a selected text into exercises.

Fig. 5 is a copy of a screen showing the user interface in connection with the embodiment of Fig. 1.

Fig. 6 shows the structure of the learners' competence profile in accordance with a preferred embodiment of the invention.

Fig. 7 shows the structure of the general language database of the learners' competence profile of Figure 7 in accordance with a preferred embodiment of the invention.

Fig. 8 shows the structure of the competence database of the learners' competence database of Figure 7 in accordance with a preferred embodiment of the invention.

Fig. 9 shows the structure of the learner database of the learners' competence profile of Figure 7 in accordance with a preferred embodiment of the invention.

Fig. 10 is a block diagram illustrating the logical flow of a method of generating personalized language exercises in accordance with a preferred embodiment of the invention.

Fig. 11 is a table illustrating how the learners' competence profile is updated in accordance with a preferred embodiment of the invention.

Fig. 12 is a block diagram illustrating a system for personalized language exercise generation in accordance with an alternative embodiment of the invention.

Detailed Description of Specific Embodiments

In accordance with a preferred embodiment of the invention, it is possible to instantaneously generate various language exercises that are tailor-made for a learner utilizing any freely chosen text or a text specifically matched to the learners' interests. Fig. 1 is a block diagram illustrating a

system for personalized language exercise generation in accordance with a preferred embodiment of the invention. Embodiments of the present invention may be implemented as software for use on a personal computer running an operating system such as Windows 95 or Windows NT, version 4, Windows 2000 Professional or the Windows 2000 Server Family available from Microsoft Corporation, Redmond, Washington. As used in this description and the following claims, a "teacher" is person who creates the exercise(s), and a "student" or "learner" is the person who does the exercise(s).

Returning to Figure 1, text is imported from a digital source at the text input 10. A language learner will be especially motivated to work on text material that is related to his or her sphere of interests and/or activities. A learner's interest profile 16 is coupled to the text input 10 such that the text selected will match the specific interests of the learner or learners. The learners' interest profile 16 holds and keeps track of the learners' interests. The learners interest profile 16 may contain positive (*i.e.*, interested in) and negative (*i.e.*, not interested in or forbidden texts or sites) information. A learners interest agent keeps track of the learners interest profile 16 and updates the learners' interest profile 16 every time a document or text is chosen. By selecting text that matches the interests of the learner, one of the main conditions for effective learning is fulfilled, namely being interested in the subject-matter of the text.

In a preferred embodiment, the selected text may be imported from the Internet. The Internet is an immensely rich source of information from which to choose text that may be used to generate language exercises. One can find for instance, at any moment of the day, interesting newspaper articles on the Internet and use this as a basis to generate learning material. Accordingly, in a preferred embodiment, a Web agent 17 is coupled to the learners' interest profile 16 to optimize text selection from the Internet such that the text selected matches the interests of the learner. The Web agent 17 may search the Internet

for texts that match the interest of the learner as specified in the learners interest profile 16.

Once the text is selected and imported into the system, the text is subjected to linguistic analysis by a linguistic analyzer 11. The linguistic analysis is advantageously executed on the phrase level as well as the word level. In other words, both morphological analysis and syntactic analysis is performed by the linguistic analyzer 11. The linguistic data resulting from these analyses are one of the basic components for the system to generate personalized, interactive language exercises. Morphological analysis is conducted on the individual words in the text and syntactic analysis is conducted on the individual words' relations in the sentence in the text. By analyzing the word and the context in which it is being used, the level of ambiguity in the labeling process will be substantially reduced. Since the results of the linguistic analysis serve as input for the transformation of texts into exercises, this in turn will substantially enhance and refine the exercise generation process.

In order to process the document provided at the text input 10, the text of the document is first separated from the other document components, such as, for example, mark-up data, pictures and annotations in the case of an HTML-document. Figures 2A and 2B are block diagrams illustrating the logical flow of the morphologic and syntactic analysis performed by the linguistic analyzer 11 of Figure 1. As mentioned above, once a text has been selected and imported, it is subjected to both morphologic and syntactic analysis. Figure 2A shows a preferred embodiment of the logical flow of the morphological analysis of the text. First, it is determined whether the end of the text file has been reached in item 201. If the end of the text file has been reached, the processing continues with the syntactic analysis of the text as shown in Figure 2B.

Returning to Figure 2A, if the end of the text file has not been reached,

the next largest data stream is identified in item 202. Next, it is determined whether the identified data stream is possibly a word in item 203. If the data stream is not a word, processing returns to item 201. If the identified data stream is a word, then the stream is morphologically analyzed at item 204. The morphological analysis may be performed using techniques of general use in the art. During this analysis, linguistic characteristics of the word are identified, such as, for example, the part-of-speech of the word or whether the word is plural or singular. If the analysis results are recognized in item 205, then the data stream and its associated lexical information are added to the internal representation of the text at item 207.

If, however, the morphological analysis results are not recognized, the data stream may be further analyzed as shown in items 208-211. At item 208, the data stream is separated into its possible components. Each component will be morphologically analyzed at item 209 until the end of the original data stream has been reached at item 211.

As mentioned above, when the end of the text file is reached at item 201, the linguistic processing continues with the syntactic analysis as show in Figure 2B. The syntactic analysis may be performed using techniques of general use in the art. Each sentence in the text file may be analyzed at item 216. The results of the syntactic analysis of a sentence are then used to refine the lexical analysis information of each word in the sentence at item 217. The process of items 217-219 are repeated for each word within the sentence until the end of the sentence has been reached at item 218. The syntactic analysis is performed for each sentence in the text file until the end of the text file is reached at item 214.

Returning to Figure 1, the other main component utilized by the system to generate personalized interactive language exercises is a learner's competence profile 15. The learners' competence profile 15 is a model for the students' language proficiency, i.e. lexical, grammatical, semantic and

phonological competencies. By creating exercises that are directed towards a specific learner's abilities, the learner is not discouraged by being confronted with exercises which are either too difficult, too easy or not relevant. Accordingly, the learners' competence profile database 15, which models the learner's extent of mastery of the target language at any given moment, is coupled to an exercise generator 12. The exercise generator 12 is also coupled to the linguistic analyzer 11 that, as discussed above, provides linguistic data for the selected text. By focusing on the learner's specific interest and ability level while generating the learning material, preferred embodiments of the invention provide significantly enhanced language learning effectiveness. In this way the system builds a bridge between the learner's field of interest, exemplified by the selected text, and the learner's specific ability level, which is represented in the learners' competence profile 15.

The learners' competence profile 15 contains a digital representation of the learners' current language proficiency, i.e. the learners' lexical, grammatical, semantic and phonological competence. A competence agent maps and updates the learners' competence profile 15. The competence agent updates the learners' competence profile after every relevant event, such as the completion of an exercise. In this manner, after every relevant learning event, the system adapts itself to the learner's progress. Specific parameters of the language exercise(s) are updated in the learners' competence profile 15. Parameters advantageously handled by the system are: 1) right and wrong answers; 2) the number of times a new word or grammatical rule has been treated; 3) the context in which a new word or grammatical rule has been treated; 4) the last time an element was treated; and 5) the lapse of time for solving the exercise.

Fig. 3 is a table identifying parameter characteristics associated with the learners' competence profile of Fig. 1. There is at present no general theory of linguistic competence that commands general acceptance. The scheme shown

in Fig. 3 aims to offer parameters and categories that are useful for the description of linguistic content. The system distinguishes among lexical competence (column 32 in Figure 3), grammatical competence (column 34 in Figure 3), semantic competence (column 36 in Figure 3), and phonological competence (column 38 in Figure 3).

Lexical competence is the knowledge of, and ability to use, the vocabulary of a language. Lexical competence consists of both lexical elements and grammatical elements as shown in column 32 of Figure 3. For example, lexical elements may be fixed expressions or single word forms and grammatical elements may be articles, conjunctions or prepositions. Grammatical competence is the knowledge of, and ability to use, the grammatical resources of a language. The grammar of a language may be seen as the set of principles governing the assembly of elements into meaningful labeled and bracketed strings (*i.e.*, sentences). Grammatical competence is the ability to understand and express meaning by producing and recognizing well-formed phrases and sentences in accordance with these principles, in contrast to memorizing and reproducing them as fixed formulae. Examples of the different grammatical resources are shown in column 34 of Figure 3, such as morphemes, active/passive voice and conjugations.

Semantic competence deals with the learner's awareness and control of the organization of meaning as shown in column 36 of Figure 3. For example, lexical semantics involve questions of word meaning. Grammatical semantics involve the meaning of grammatical elements, categories, structures and processes. Pragmatic semantics involve logical relations such as entailment, presupposition and implicature. Phonological competence involves a knowledge of, and skill in the perception and production of sound units, including the phonetic features which distinguish phonemes, the phonetic composition of words, sentence phonetics, and phonetic reduction. Examples of phonological competence are shown in column 38 of Figure 3.

Returning to Figure 1, information from the learners' competence profile 15, together with information obtained from the linguistic analysis of the text by the linguistic analyzer 11, serve as input for the exercise generator 12. The exercises to be generated are mainly the result of a matching process of text content and the content of the learners' competence profile 15. When the exercise generator 12 generates a new series of exercises for a learner or group of learners, the competence agent accesses the learners' competence profile 15. By screening the newly imported text against the information in the learners' competence profile 15, the system is able to generate exercises that are specifically directed to a specific learner or group of learners.

Fig. 4 is a table setting forth, with respect to the embodiment of Fig. 1, user preferences 40 available in generating exercises using the selected text. Generating an exercise is a two-step process: 1) selecting the words to generate an exercise on; and 2) adding data to these words and setting global preferences.

In the first step, words in the text may be selected either automatically or manually. When a teacher wants to select words automatically, the teacher may define which words to select. There are several ways in which a teacher can define which words for the exercise generator to select. First, the teacher may define a "mask" (*e.g.*, the mask "*ing" will select all words ending in "ing"). Second, the teacher may specify a word class in order to select all the words from the text in the specified word class (*e.g.*, select "verb" to select all possible verbs). Third, the teacher may select a word class and "extended word information" such as singular/plural (*e.g.*,. select "noun" and " plural" to select all plural nouns). Fourth, the teacher may combine "mask", "word class" and "extended word information," whereby it is possible to take into account the specific learner's competence profile. Fifth, the teacher may specify a word list. The word list may be a pre-defined word list or a word list based on the learners' competence profile. Finally, the teacher may select the position of a

word in the text. When a teacher wants to selects words manually, the teacher directly selects the word itself, for example, using a keyboard or a mouse.

In the second step, the teacher can add different kinds of didactic information to a specific word, or group of words including hints (column 46 in Figure 4), alternatives and possible feedback (column 47 in Figure 4), an image, a video or sound, or a link to a World Wide Web address (column 48 in Figure 4). A "hint" is a text, sound or image which is intended to help the student to find the right answer when doing the exercise. For example, when the student must fill in the word "computer", the text "electronic device" could appear on screen.

"Alternatives" are answers from which the student can choose. An "alternative" can be set to be a real alternative to the right answer or an anticipated wrong answer. For example, when the student must fill in the word "has", two alternatives could appear on screen from which one has to make a choice: "has" and "have". When the student chooses the right answer, in this example "has", supporting information may also be provided to the student. This supporting information is called "feedback". The teacher may also select various other preferences such as adding an image, a video or sound, or a link to a World Wide Web address. The teacher may also combine steps 1 and 2 by using a "favorites" designation to generate basic predefined exercise types. Figure 5, is a copy of a computer display showing the user interface in connection with the embodiment of Figure 1. Figure 5, illustrates the "favorite" option available to a user.

Besides adding data to words, the teacher may also specify global parameters which will effect the entire exercise. For example, the teacher may specify that all selected words must appear in a list on top of the text when solving the exercise, or that the infinitive of verbs must appear in brackets. The teacher may also specify how many times an exercise can be solved, the maximum time allowed to solve an exercise, how words should be substituted,

and if error analysis should be active. As shown in Figure 1, a student or learner 14 will complete the exercise(s) producing a set of results 14. The results 14 of each exercise completed by the learner are fed back into a database for the learner in the learners' competence profile 15. As discussed above, the competence agent keeps track of information concerning the actual level of language knowledge and mastery and updates the learners' competence profile 15. In this manner, the learners' competence profile 15 may be continuously and automatically updated with the newly obtained information about the learner's language knowledge.

The learners' competence profile 15 will now be discussed in more detail with respect to Figures 6-11. As shown in Figure 6, the learners' competence profile contains a general language database 60, a learners database 62 and a competence database 64. The general language database 60 includes entries for all of the known words, phrases and rules for a given language, including, for, example single word forms, synonyms/antonyms, neologisms, word groups, collocations, fixed expressions, idioms and grammatical rules. In a preferred embodiment, a user may also add entries to the general language database 60. The learners database 62 includes a separate database of information for each learner or student using the system. The learners database 62 is a specific subset of the general language database 60. As such, each entry in the learners database 62 for a learner N has a corresponding entry in the general language database 60. The competence database 64 includes the different types of competence items which may be evaluated using the exercises generated by the system.

A preferred structure of the general language database 60 is shown in Figure 7. Each entry 71 refers to a type(or classification) 72 of word, phrase or rule. The following classifications may be utilized by the general language database:

a) Type 1: single word forms. An entry for a single word form

will include the dictionary base forms, a word description and the attributes of the word. For example, the word "people" is a noun and has the attribute of being uncountable.

b) Type 2: fixed expressions. The fixed expressions are a definite set of the most frequently used expressions in the given language.

c) Type 3: idioms

d) Type 4: terminology

e) Type 5: synonyms/antonyms

f) Type 6: neologisms

g) Type 7: collocations

h) Type 8: word groups, *e.g.*, phonological or contrastive pairs

i) Type 9: grammatical rules and accompanying word class and extended word information combination.

As shown in Figure 7, each entry in the general language database preferably includes one or more of following fields:

a. Type or classification (e.g. Type 1: single word form) (see column 72 in Figure 7)

b. Word class (e.g. noun) (see column 73 in Figure 7)

c. Value (e.g."people") (see column 74 in Figure 7)

d. Level (basic, threshold, proficiency, mastery) (see column 76 in Figure 7)

e. Competence item (related to competence database) (see column 77 in Figure 7)

The competence item 77 refers to a competence item from the competence database 64 (Figure 6). Each entry in the general language database is related to the competence item designated in the competence item field 77. A preferred structure of the competence database is shown in Figure 8. The competence database includes numerous competence items such as, for example, grammatical rules and lexical items. Each entry in the competence

database preferably includes one or more of the following fields:

a. Type: general rule or item-specific rule (see column 82 in Figure 8)

b. Description of the competence item (see column 83 in Figure 8)

c. Word class: word classes and extended word information corresponding to the competence item. (see column 84 in Figure 8)

d. Competence type: lexical, grammatical, semantic or phonological (see column 85 in Figure 8)

For example, competence item 5 of the competence database shown in Figure 8, is an item-specific rule for the formation of the irregular simple past form of a verb. The rule is a grammatical competence type. As mentioned above, the general language database classifies each of its entries as relevant to a particular competence item in the competence database. For example, entry 2 in the general language database (Figure 7) is relevant to the first competence item in the competence database as shown in Figure 8.

A preferred structure for the learner's database is shown in Figure 9. Figure 9 illustrates a profile for a particular student N. As mentioned above, the learners database includes a separate profile for each student (1 to N) who uses the system. Each entry of the learners database for a student N refers to a corresponding entry in the general language database (Figure 7) and indicates the student's score for exercises pertaining to the particular word or rule. Each entry in the learners database preferably includes one or more of the following fields:

a. score: The score is a measure of the competence level of the student for this word, phrase or rule. In a preferred embodiment, the score is a value between -1 and 1. If the score is less than zero, then the corresponding item in the general database has been the subject of an exercise but is unknown to the student. If the score is greater than zero, the corresponding item in the general database has been the subject of

an exercise and is known by the student. If the score is equal to zero, the corresponding item in the general database has not been the subject of an exercise completed by the student. The absolute value of the score is an indication of the degree of knowledge of the student with regard to the corresponding item in the general language database. (see column 92 in Figure 9)

b. +answers: the number of correct answers for the corresponding item in the general language database. (see column 93 in Figure 9)

c. -answers: the number of incorrect answers for the corresponding item in the general language database. (see column 94 in Figure 2)

d. contexts: the context in which the item was solved (correctly or incorrectly). (see column 95 in Figure 9)

e. last time exercise solved: the date and time of last time the item was solved (correctly or incorrectly). (see column 96 in Figure 2)

The learners competence level for a particular competence item (i) in the competence database may be calculated using data from the learners database. In a preferred embodiment, the competence level for a competence item (i) is a function of the scores (i) for all entries from the learners database which relate to the competence item (i).

As a student completes an exercise(s), the learners database (see Figure 9) is updated and a new score calculated for the item involved in the exercise(s). Figure 10 is a block diagram illustrating the logical flow of a method of generating personalized language exercises associated with a preferred embodiment of the invention. Figure 11 is a table illustrating how the learners' competence profile (See Figure 6) is updated using the results of the exercise(s) completed by the student. The process of creating exercises and updating the learners competence profile based on the results of the

exercises completed by the student will be discussed with respect to Figures 10 and 11.

Referring to Figure 10, the teacher or the system selects a text in item 100. As discussed above with respect to Figure 1, the text may be selected using a learners' interest profile such that the text selected matches the interests of the learner. The selected text will then be received at the text input and imported into the system in item 102. Once the text is imported into the system, it is subjected to both morphological and syntactic analysis to determine the linguistic information associated with the text in item 104. As discussed above with respect to Figure 1, the morphological and syntactic analysis may be performed using techniques of general use in the art.

The linguistic data and the information in the learners competence profile are used to generate language exercises for the student in item 106. Based on the information in the learners' competence profile for a particular learner or group of learners, the system may select competence items from the competence database which have not yet been mastered by the student. In a preferred embodiment, if the competence level for a competence item (i) is less than a minimum competence value, the competence item (i) is selected as a candidate for exercise generation. The minimum competence value is a constant predetermined parameter. If the competence level for a competence item (i) is greater than the minimum competence value, the competence item (i) is defined as "known" and therefore not selected as a candidate for exercise generation.

Based on the selected competence items from the competence database, words and phrases that are related to the selected competence items are selected from the text. For a general rule competence item, all words with the corresponding word classe(s) and extended word information are selected for exercise generation. For an item-specific rule competence item, all the unknown words or rules corresponding to the competence item are selected

for exercise generation. If too few or too many words are selected, the selected text may be defined as not suitable for the competence level of the learner. In this case, the teacher may then select another competence item or another text.

Once the competence items and corresponding words and/or rules are selected, the teacher may set his/her preferences and create an exercise(s) with the selected text items. As discussed above with respect to Figure 4, there are numerous preferences which may be selected by the teacher. Preferably, an exercise includes:

a) the title and description of the exercise
b) the number of times a particular field may be filled in
c) the time allowed to do the exercise
d) how the fields may be replaced
e) the evaluation per field or when the exercise is completed
f) the type of hint and/or activation of hint
g) error analysis yes/no
h) drag and drop yes/no
i) the identification of teacher

Once the exercise or exercises are generated, the exercise(s) may be completed by the learner or student in item 108. The results of the exercises completed by the student are then used to update the learners' competence profile in item 109. Figure 11 is a table illustrating how the learners' competence profile is updated. Figure 11 illustrates text items selected for exercises relating to a grammatical rule on the formation of irregular simple past word forms and the formation of regular simple past word forms. Table 110 in Figure 11 shows the text items selected, the answers given by the student and whether the answer given was correct (1) or incorrect (0). Table 112 in Figure 11 shows the corresponding entries in the general language

database for the selected text items.

The results of the exercises completed by the student, as shown in Table 110, may be used to update the learners' database for the learner in the learners' competence profile. The following parameters are updated for each entry in the learners database corresponding to the words or rules used in the exercises:

a) Right or wrong answers

b) Number of times the item has been treated

c) Context in which the item has been treated

d) Last time the item has been treated

e) Lapse of time

Table 114 in Figure 11 shows the learners database for a learner N and the fields updated with the results of the exercises as shown in Table 110. The score for an existing entry will be recalculated using the exercise results. In addition, new entries will be created for items that have been addressed for the first time by learner N. In a preferred embodiment, the new score for an item is a function of the previous score, whether the current answer is correct or incorrect, the number of correct answers for the item, the number of incorrect answers for the item, the context in which the item is solved and the amount of time taken to solve the exercise.

Figure 12 is a block diagram of a system for generating personalized language exercises in accordance with an alternative embodiment of the invention. In accordance with the alternative embodiment, various language exercises are selected from a central language exercise database such that the selected exercises match the competence level of a learner.

A basic component of the system of Figure 12 is a language exercise database 120 that contains all the data necessary to generate an exercise. In a preferred embodiment, this data may include a particular text, a list of selected words or word-groups, additional information for each of these words or

word groups and general exercise parameters. The exercises in the language exercise database 120 may have an associated competence level. The associated competence levels may be used to select exercises from the language exercise database 120 that match the learner's competence level. Accordingly, the other main component of the system is the learners' competence profile 128 that is a model for the learner's language proficiency, i.e. lexical, grammatical, semantic and phonological competencies. A competence agent maps and updates the learners' competence profile 128.

Based on these two components, a teacher can generate, with the help of the system, a series of language exercises taking into account the learners' competence level in the target language. In a preferred embodiment, the language exercises are directed towards correct pronunciation, text comprehension, vocabulary and grammar.

The results of each exercise completed by the learner are fed back into the learner's database for the learner in the learners' competence profile 128. As discussed above with respect to Figure 1, the learner's competence profile 128 may be continuously and automatically updated with the newly obtained information about the learners' language knowledge. The learners competence profile 128 is updated in a similar manner to that described with respect to Figures 10 and 11 above.

An exercise generator 122 is coupled to the language exercises database 120 and the learners' competence profile 128. The exercise generator 122 may select exercises from the language exercise database 120 that match the learners' competence level. First, the teacher selects a theme or exercise type. Next, based on the learner's profile from the learner's competence profile 128, a set of exercises is selected from the language exercise database 120. For example, exercises may be selected as follows:

a) For an exercise on a "general rule" competence item, if the competence level of the learner for the competence item (i) is less than a

minimum competence value, the exercise is selected.

b) For a "item-specific rule" competence item, if more than a minimum percentage of the selected items in the exercise are unknown, the exercise will be selected.

Once the exercises are selected, the student 124 will complete the exercises and produce a set of results 126. The results 126 will then be used to update the learners competence profile 128.

The described embodiments of the invention are intended to be merely exemplary and numerous variations and modifications will be apparent to those skilled in the art. All such variations and modifications are intended to be within the scope of the present invention as defined in the appended claims.

What is claimed is:

1. A system for personalized language exercise generation, the system comprising:

a. a text input for receiving a selected text;

b. a linguistic analyzer coupled to the text input for analyzing the selected text;

c. an exercise generator coupled to the linguistic analyzer for generating a language exercise from the selected text; and

d. a learner's profile database, coupled to the exercise generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learner's profile database.

2. A system according to claim 1, wherein the linguistic analyzer includes a morphology analyzer and a syntax analyzer.

3. A system according to claim 1, further comprising:

e. a scoring arrangement for scoring the results of use of the exercise and for updating the learner's profile database based on the performance of the user in doing the exercise.

4. A system according to claim 1, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

5. A system according to claim 4, wherein the profile data includes parameters separately characterizing at least one item selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

6. A system according to claim 5, wherein the profile data includes parameters separately characterizing at least two items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

7. A system according to claim 5, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

8. A method for generating a personalized language exercise, the method comprising:

a. receiving a selected text at a text input;

b. linguistically analyzing the selected text to produce analytical data;

c. retrieving user data from a learner's profile database, stored in a digital storage medium, pertinent to a user; and

d. generating an exercise based on the selected text, the analytical data, and the user data.

9. A method according to claim 8, wherein linguistically analyzing the selected text includes analyzing both morphology and syntax of the text.

10. A method according to claim 8, further comprising:

e. scoring the results of use of the exercise and updating the learner's profile database based on the performance of the user in doing the exercise.

11. A method according to claim 8, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

12. A method according to claim 11, wherein the profile data includes parameters separately characterizing at least one item selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

13. A method according to claim 12, wherein the profile data includes parameters separately characterizing at least two items selected from

the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

14. A method according to claim 12, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

15. A digital storage medium digitally encoded with instructions, which when loaded into a computer establish a system for personalized language exercise generation, the system comprising:

a. a text input for receiving a selected text;

b. a linguistic analyzer coupled to the text input for analyzing the selected text;

c. an exercise generator coupled to the linguistic analyzer for generating a language exercise from the selected text; and

d. a learner's profile database, coupled to the exercise generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learner's profile database.

16. A medium according to claim 15, wherein the linguistic analyzer includes a morphology analyzer and a syntax analyzer.

17. A medium according to claim 15, wherein the system further comprises:

e. a scoring arrangement for scoring the results of use of the exercise and for updating the learner's profile database based on the performance of the user in doing the exercise.

18. A medium according to claim 15, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

19. A medium according to claim 18, wherein the profile data

includes parameters separately characterizing at least one item selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

20. A medium according to claim 18, wherein the profile data includes parameters separately characterizing at least two items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

21. A medium according to claim 18, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

22. A system for personalized language exercise generation, the system comprising:

a. a language exercise database

b. an exercise generator coupled to the language exercise database, the exercise generator for selecting a language exercise from the language exercise database ; and

c. a learner's profile database, coupled to the exercise generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learner's profile database.

23. A system according to claim 22, further comprising:

e. a scoring arrangement for scoring the results of use of the exercise and for updating the learner's profile database based on the performance of the user in doing the exercise.

24. A system according to claim 23, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

25. A system according to claim 24, wherein the profile data includes

parameters separately characterizing at least one item selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

26. A system according to claim 24, wherein the profile data includes parameters separately characterizing at least two items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

27. A system according to claim 24, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

28. A method for generating a personalized language exercise, the method comprising:

a. retrieving exercises from a language exercise database, stored in a digital storage medium;

b. retrieving user data from a learner's profile database, stored in a digital storage medium, pertinent to a user; and

c. selecting a language exercise from the language exercise database, based on the user data.

29. A method according to claim 28, further comprising

d. scoring the results of use of the exercise and updating the learner's competence profile database based on the performance of the user in doing the exercise.

30. A method according to claim 29, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

31. A method according to claim 30, wherein the profile data includes parameters separately characterizing at least one item selected from

the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

32. A method according to claim 30, wherein the profile data includes parameters separately characterizing at least two items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

33. A method according to claim 30, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

34. A digital storage medium digitally encoded with instructions, which when loaded into a computer establish a system for personalized language exercise generation, the system comprising:

a. a language exercise database;

b. an exercise generator coupled to the language exercise database, the exercise generator for selecting a language exercise from the language exercise database; and

c. a leaner's profile database, coupled to the exercise generator, in such a manner that the language exercise reflects parameters of a user with respect to whom there exists an entry in the learner's profile database.

35. A medium according to claim 34, wherein the system further comprises:

d. a scoring arrangement for scoring the results of use of the exercise and for updating the learner's profile database based on the performance of a user in doing the exercise.

36. A medium according to claim 35, wherein the learner's profile database includes profile data for a non-null set of learners, such profile data including parameters characterizing, for each learner in the set, such learner's linguistic competence.

37. A medium according to claim 36, wherein the profile data includes parameters separately characterizing at least one item selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

38. A medium according to claim 36, wherein the profile data includes parameters separately characterizing at least two items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

39. A medium according to claim 36, wherein the profile data includes parameters separately characterizing at least three items selected from the group including lexical competence, grammatical competence, semantic competence, and phonological competence.

96694

FIGURE 1

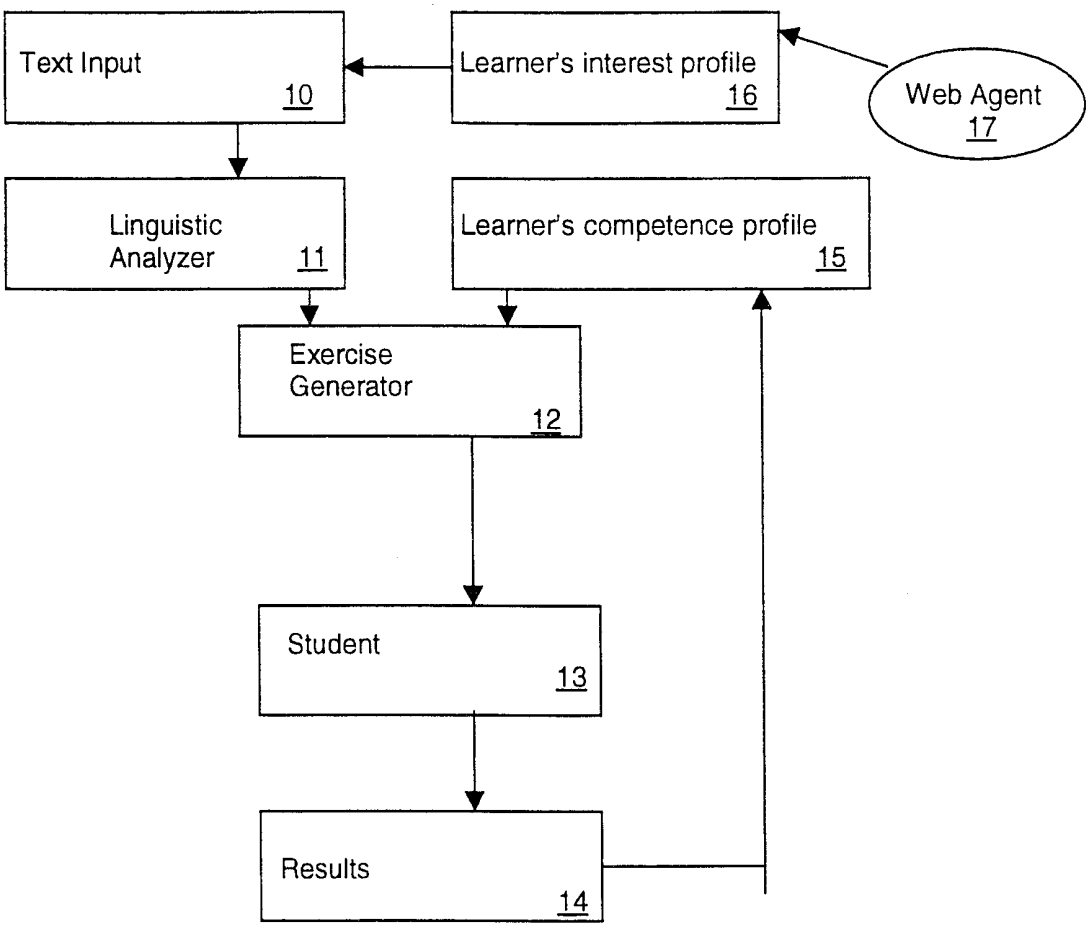

Text Input
10
Learner's interest profile
16
Web Agent
17
Linguistic
Analyzer
11
Learner's competence profile
15
Exercise
Generator
12
Student
13
Results
14

Figure 2A

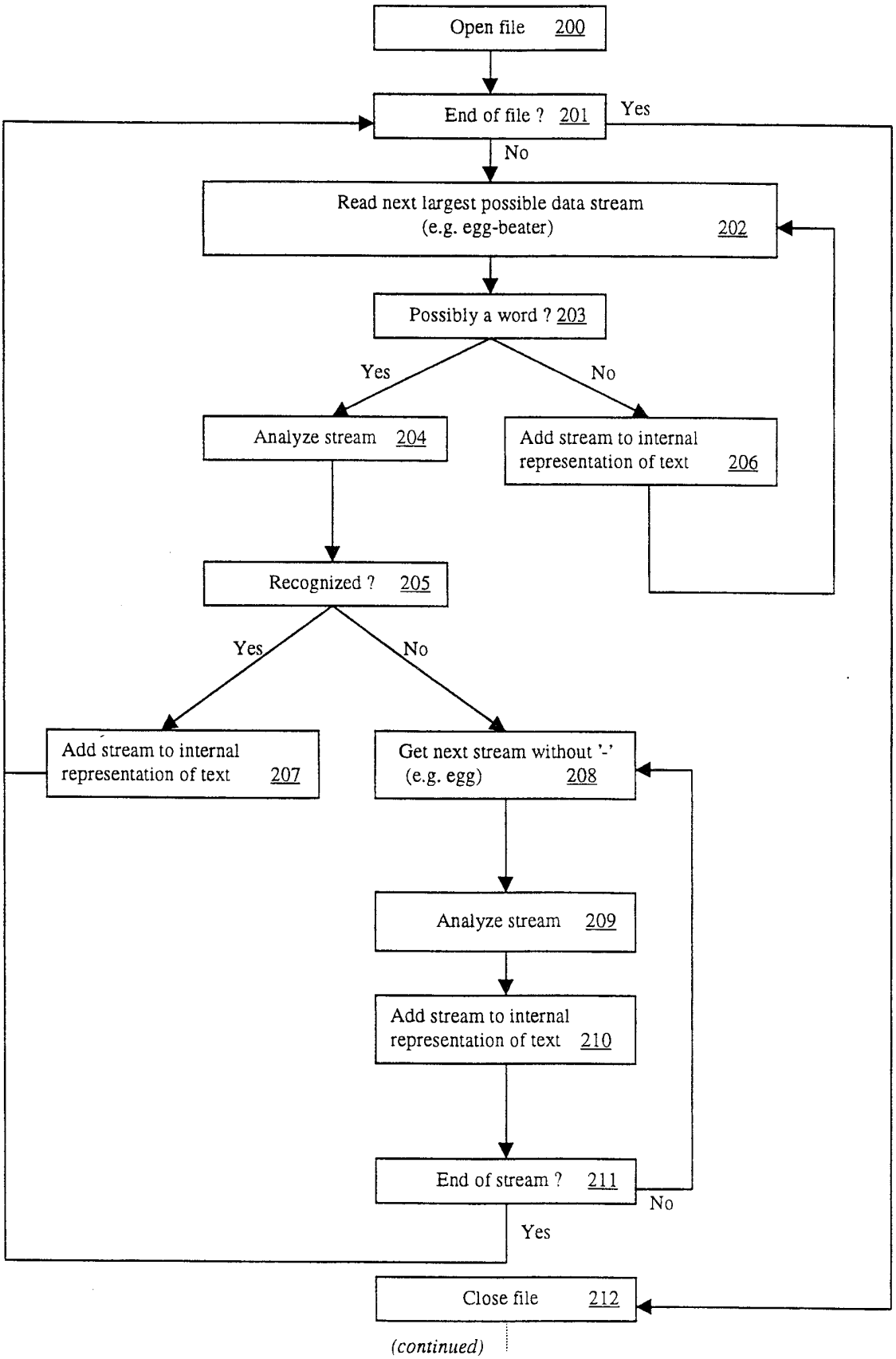

Open file 200
End of file ? 201
Yes
No
Read next largest possible data stream (e.g. egg-beater) 202
Possibly a word ? 203
Yes
No
Analyze stream 204
Add stream to internal representation of text 206
Recognized ? 205
Yes
No
Add stream to internal representation of text 207
Get next stream without '-' (e.g. egg) 208
Analyze stream 209
Add stream to internal representation of text 210
End of stream ? 211
No
Yes
Close file 212
(continued)

Figure 2B

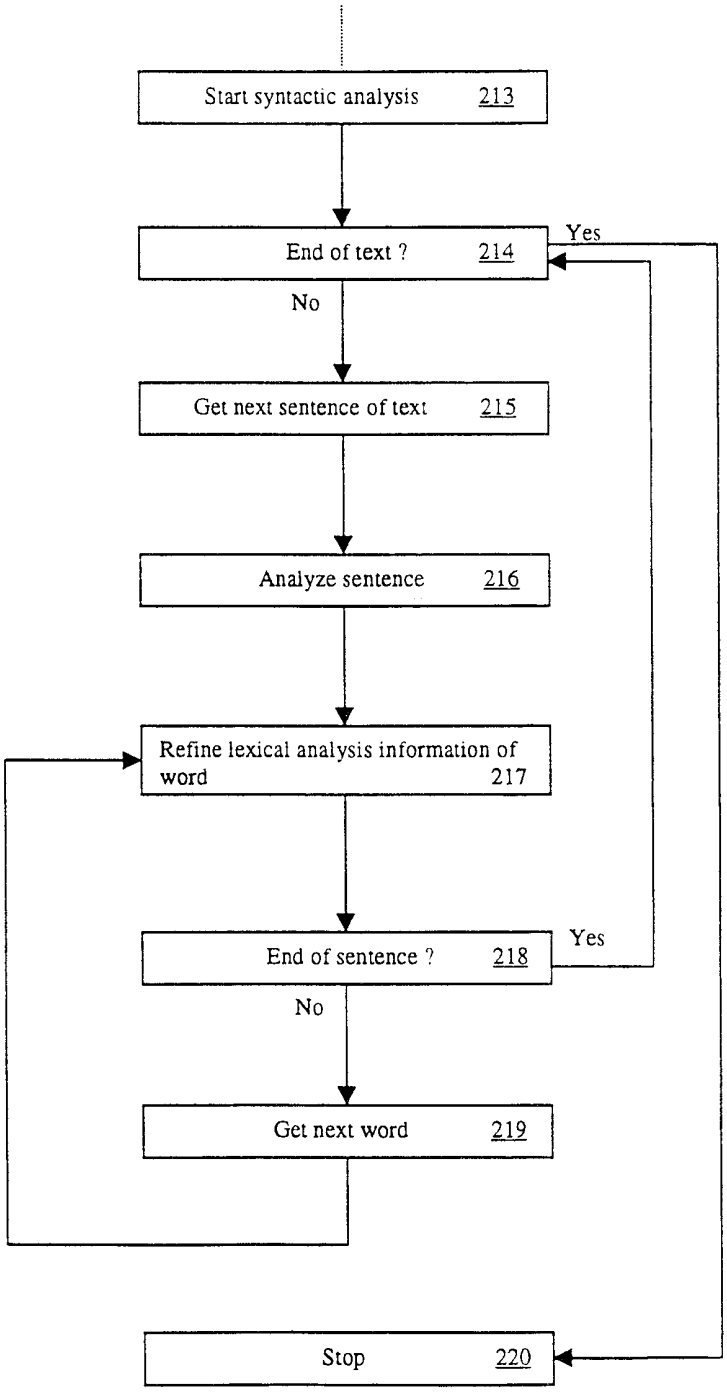

Start syntactic analysis 213
End of text ? 214
Yes
No
Get next sentence of text 215
Analyze sentence 216
Refine lexical analysis information of word 217
End of sentence ? 218
Yes
No
Get next word 219
Stop 220

Figure 3

LINGUISTIC COMPETENCES 30			
Lexical competence 32	**Grammatical competence 34**	**Semantic competence 36**	**Phonological competence 38**
a. Lexical elements - fixed expressions - single word forms b. Grammatical elements - articles e.g. a, the - quantifiers e.g. some, all, many - demonstratives e.g. this, that, these - personal pronouns e.g. I, we, he - question words and relatives e.g. who, what, which - possessives e.g. my, your, his - prepositions e.g. in, at, by - auxiliary verbs e.g. be, do, have - conjunctions e.g. and, but, if - particles e.g. in German: ja, wohl, aber	a. Elements, e.g. - morphs, - morphemes-roots and affixes - words b. Categories, e.g. - number, case, gender - concrete/abstract, countable/uncountable - active/passive voice c. Classes, e.g. - conjugations - declensions - open word classes d. Structures, e.g. - compound and complex words - phrases - clauses e. Processes, e.g. - nominalisation - affixation - suppletion - gradation - transposition f. Relations, e.g. - government - concord - valency	a. Lexical semantics deals with questions of word meaning, e.g. - relation of word to general context: - reference - connotation - exponence of general specific notions - interlexical relations: - synonymy/ antonymy - hyponymy - collocation - part-whole relations - componential analysis - translation equivalence b. Grammatical semantics deals with the meaning of grammatical elements, categories, structures and processes c. Pragmatic semantics deals with logical relations such as entailment, presupposition, implicature, ...	a. Sound-units (phonemes) of the language and their realisation in particular contexts (allophones) b. Phonetic features which distinguish phonemes (distinctive features, e.g. voicing, rounding, nasality, plosion) c. Phonetic composition of words (syllable structure, the sequence of phonemes, word stress, word tones) d. Sentence phonetics (prosody) - sentence stress and rhythm - intonation e. Phonetic reduction - vowel reduction - strong and weak forms - assimilation - elision

Figure 4

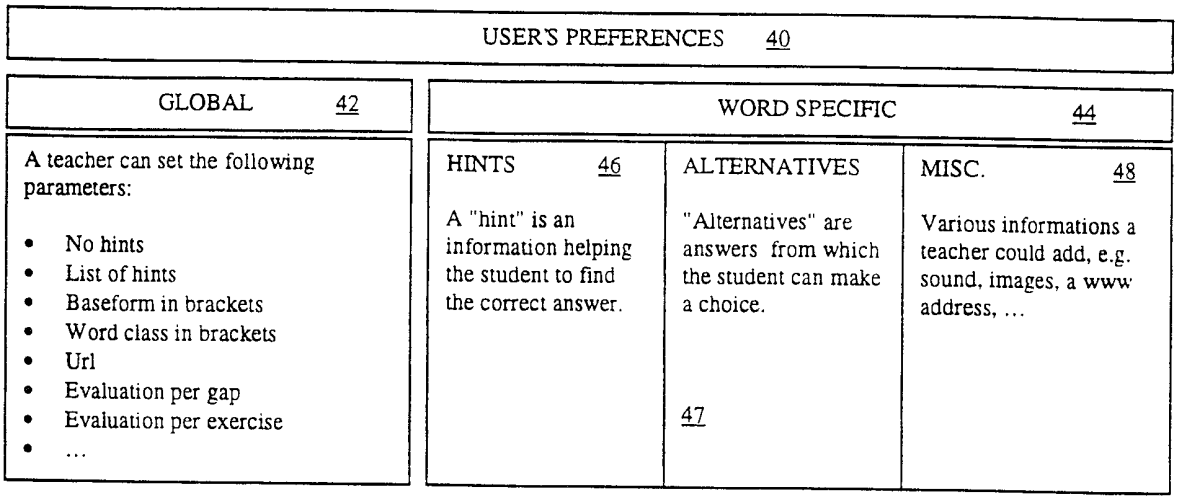

USER'S PREFERENCES 40
GLOBAL 42
WORD SPECIFIC 44
A teacher can set the following parameters:
• No hints
• List of hints
• Baseform in brackets
• Word class in brackets
• Url
• Evaluation per gap
• Evaluation per exercise
• ...
HINTS 46
A "hint" is an information helping the student to find the correct answer.
ALTERNATIVES
"Alternatives" are answers from which the student can make a choice.
47
MISC. 48
Various informations a teacher could add, e.g. sound, images, a www address, ...

Figure 5

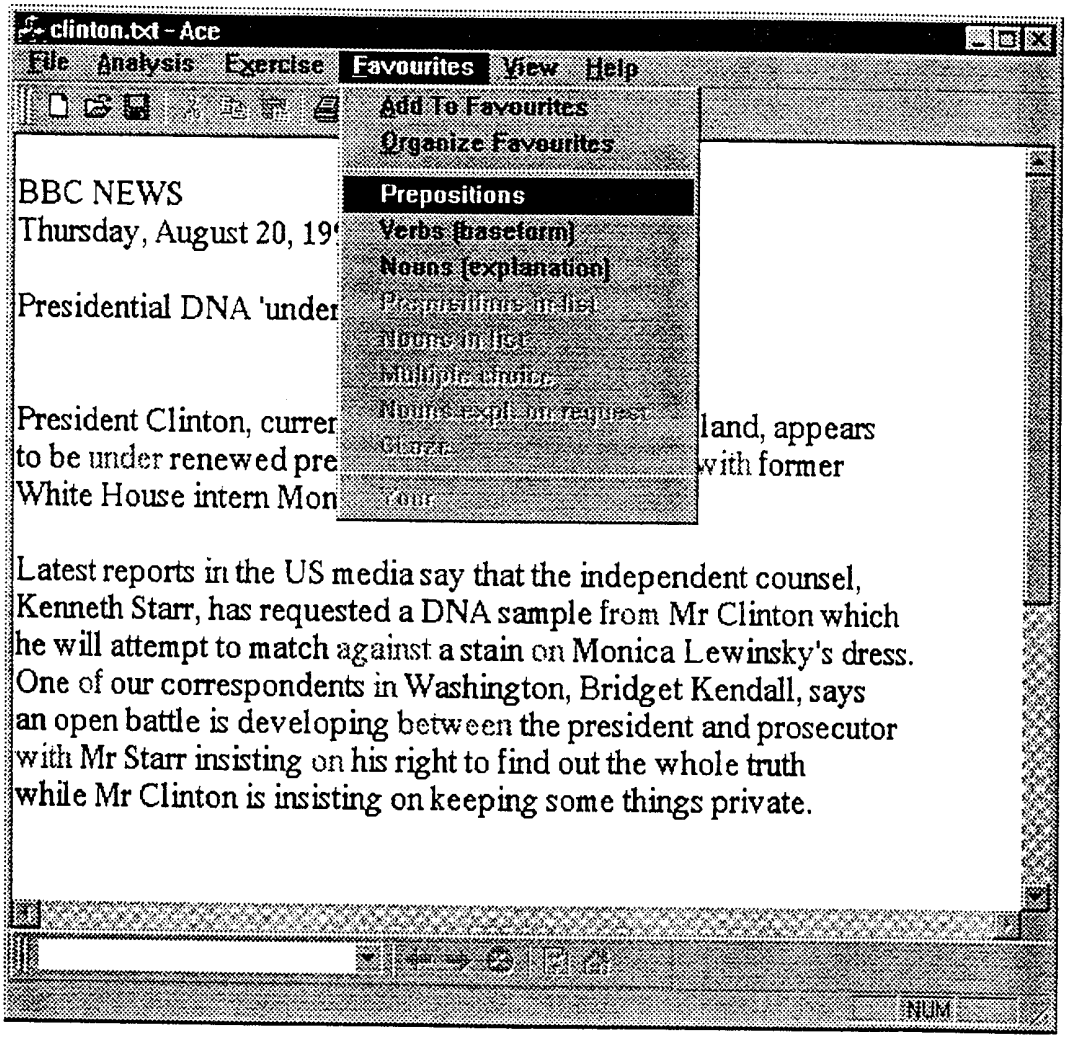

clinton.txt - Ace
File Analysis Exercise Favourites View Help
Add To Favourites
Organize Favourites
Prepositions
Verbs [baseform]
Nouns [explanation]
BBC NEWS
Thursday, August 20, 19
Presidential DNA 'under
President Clinton, currer
land, appears
to be under renewed pre
with former
White House intern Mon
Latest reports in the US media say that the independent counsel, Kenneth Starr, has requested a DNA sample from Mr Clinton which he will attempt to match against a stain on Monica Lewinsky's dress. One of our correspondents in Washington, Bridget Kendall, says an open battle is developing between the president and prosecutor with Mr Starr insisting on his right to find out the whole truth while Mr Clinton is insisting on keeping some things private.
NUM

Figure. 6

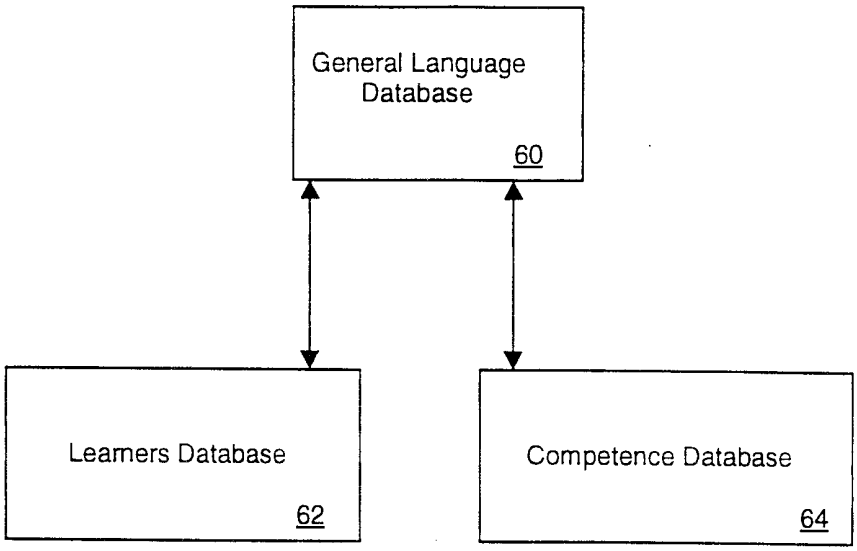

General Language Database
60
Learners Database
62
Competence Database
64

Figure 7 : General language database

Entry number 71	Type 72	Type 73	Value1 74	Value2 75	Level 76	Competence item 77
1	1(Single word)	Noun	difficult		Basic	1
2	1(Single word)	pronoun	much		Basic	1
3	1(Single word)	verb	be		Basic	1
4	1(Single word)	verb	be		Basic	5
5	1(Single word)	verb	be		Basic	6
6	1(Single word)	determiner	a		Basic	1
7	1(Single word)	determiner	the		Basic	1
10	2(Fixed Expression)		How do you do ?		Basic	1
20	3(Idiom)		He kicked the bucket			1
30	4(Terminology)	adjective	cardiovascular			1
40	5(Synonym)		good	well	Basic	1
45	5(Antonym)		good	bad	Basic	1
50	6(Neologism)		nerd		Basic	1
60	7(Collocation)					
70	8(Phonology)		Paul	pole		
100	8(Rule)		Rule 7		Basic	7

Figure 8 Competence database

Item 81	Type 82	Description 83	Wordclass 84	Competence type 85
1	Specific	Lexicon		Lex
5	Specific	Formation of irregular simple past	Verb, simple past	Gramm
6	Specific	Formation of irregular past participle	Verb, past part.	Gramm
7	General	use of simple past- past participle	Verb, simple past+ past part	Gramm
...				

Figure 9 Learner database (profiles of all users 1 to N)

Profile of User N :

Word or rule (ref. to general language DB) 91	Score 92	+ answers 93	-answers 94	Context 95	Last Time Exercise Solved 96
1	0.70	5	1	Ex. ID 200	
2	0.70	5	1	Ex. ID 200	
2	0.8	2	0	Ex. ID 230	
3	0.5	1	0	Ex. ID 190	
4	-0.3	0	1	Ex. ID 190	
5	0	1	1	Ex. ID 190	

Competence level (i) = f(scores(i)), where

Competence level (i) represents the competence level for competence item i

Scores(i) are the scores for all entries relating to competence item i

Figure 10

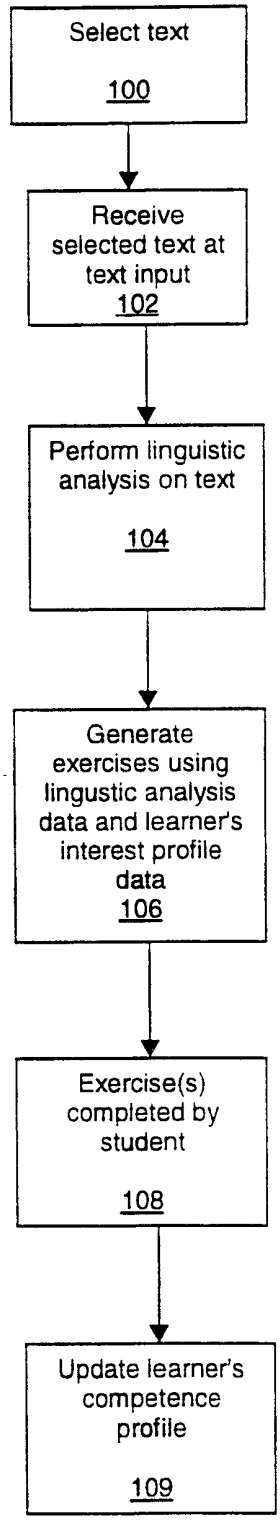

Select text
100
Receive selected text at text input
102
Perform linguistic analysis on text
104
Generate exercises using lingustic analysis data and learner's interest profile data
106
Exercise(s) completed by student
108
Update learner's competence profile
109

Figure 11

Exercise ID250 on grammatical rule 5 : formation of irregular simple past
grammatical rule 4 : formation of regular simple past

110

Text Words	answer	correct
-told	telled	0
-laughed	laughed	1
-picked	picked	1
-was	was	1
-could	could	1
-abandoned	abandoned	1
-thought	thinked	0
-went	went	1
-lapped	lapped	1

Part of general language database :

112

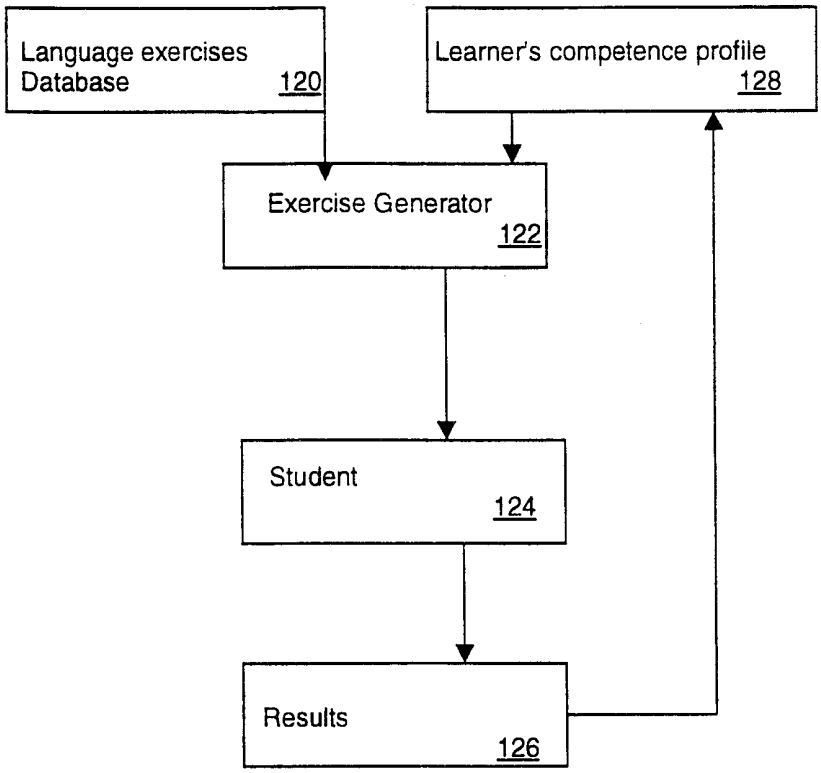
Entry number	Type	Type	Value1	Value2	Level	Competence item
1	Single word	verb	tell		Basic	5
2	Single word	verb	laugh		Basic	4
3	Single word	verb	pick		Basic	4
4	Single word	verb	be		Basic	5
5	Single word	verb	can		Basic	5
6	Single word	verb	abandon		Threshold	4
7	Single word	verb	think		Basic	5
8	Single word	verb	go		Basic	5
9	Single word	verb	lap		Threshold	4

Update of learner's competence profile- learner's database for learner N

114

Word or rule	Old Score	**New Score**	+ answers	-answers	Context
1	0.2	**0.6**	2	**1+1**	ID250
2	0.7	**0.9**	**2+1**	0	ID250
3	0.8	**0.93**	**2+1**	0	ID250
4	0.5	**0.83**	**1+1**	0	ID250
5	0.5	**0.83**	**1+1**	0	ID250
7	-0.3	**-0.65**	0	**1+1**	ID250
8	0	**0.3**	1+1	1	ID250
6		**+0.5**	**+1**		**ID250**
9		**+0.5**	**+1**		**ID250**

Figure 12


Language exercises Database 120
Learner's competence profile 128
Exercise Generator 122
Student 124
Results 126

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 99/20379

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G09B7/04 G09B5/06 G09B19/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 218 537 A (HEMPHILL CHARLES T ET AL) 8 June 1993 (1993-06-08) column 2, line 59 -column 9, line 11; claims 1-19; figures 1-4C	1-39
Y	WO 97 21201 A (BERNSTEIN JARED C) 12 June 1997 (1997-06-12) page 4, line 30 -page 11, line 24; claims 1-50; figures 1-6	1-39
A	WO 98 13807 A (SYLVAN LEARNING SYSTEMS INC ;STUPPY JOHN J (US)) 2 April 1998 (1998-04-02) the whole document	1,3,8, 10,15, 17,22, 23,28, 29,34,35

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

' Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 December 1999	22/12/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gorun, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 99/20379

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 11523 A (APPLEBY STEPHEN CLIFFORD ;BRITISH TELECOMM (GB)) 19 March 1998 (1998-03-19) the whole document	1,2,8, 15,22, 28,34
A	WO 98 25251 A (HO CHI FAI ;TONG PETER P (US)) 11 June 1998 (1998-06-11) the whole document	1,2,8, 15,22,34
A	EP 0 665 523 A (E SYSTEMS INC) 2 August 1995 (1995-08-02) the whole document	1,8,15, 22,28,34
A	EP 0 801 370 A (HUGHES AIRCRAFT CO) 15 October 1997 (1997-10-15) the whole document	1,8,15, 22,28,34
A	EP 0 838 798 A (NAT EDUCATION CORP) 29 April 1998 (1998-04-29) the whole document	1,3,8, 10,15, 17,22, 23,28, 29,34,35
A	US 5 797 753 A (JIANG WAYNE ET AL) 25 August 1998 (1998-08-25) the whole document	1,3,8, 10,15, 17,22, 23,28, 29,34,35

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ional Application No
PCT/US 99/20379

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5218537 A	08-06-1993	NONE	
WO 9721201 A	12-06-1997	AU 1128597 A	27-06-1997
		CA 2239691 A	12-06-1997
		EP 0956552 A	17-11-1999
		US 5870709 A	09-02-1999
WO 9813807 A	02-04-1998	AU 4487097 A	17-04-1998
		EP 0934581 A	11-08-1999
		NO 991183 A	10-05-1999
WO 9811523 A	19-03-1998	AU 4130297 A	02-04-1998
		EP 0925569 A	30-06-1999
WO 9825251 A	11-06-1998	US 5836771 A	17-11-1998
		EP 0946933 A	06-10-1999
		US 5934910 A	10-08-1999
		US 5884302 A	16-03-1999
EP 0665523 A	02-08-1995	US 5810599 A	22-09-1998
		JP 8083041 A	26-03-1996
EP 0801370 A	15-10-1997	CA 2202105 A	09-10-1997
		JP 10039741 A	13-02-1998
		US 5885083 A	23-03-1999
EP 0838798 A	29-04-1998	AU 4284097 A	30-04-1998
		JP 10207335 A	07-08-1998
US 5797753 A	25-08-1998	US 5749736 A	12-05-1998
		US 5890911 A	06-04-1999
		US 5797754 A	25-08-1998