

Learning Analytics for Interpreting

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Abstract: An important activity in the life of interpreters is terminology work. A primary method for learning technical vocabulary is the creation of personal glossaries. The current paper describes the design and creation of a system that guides the students in autonomous vocabulary work, supports the students' learning progress, and helps the teacher in monitoring the student commitment to and achievements in the creation of personal glossaries. The system includes a tool for the creation of glossaries, a tracking system that records the students' actions and the websites they visit while searching the Web for linguistic and content information, and a learning analytics dashboard. The system was tested on a class of 34 university students training in interpreting and the paper reports some preliminary results.

1 INTRODUCTION

Interpreter training is a challenging task, especially in academic institutions, where teachers are required to train perspective interpreters in a wide range of cognitive, linguistic and practical skills (e.g. Pöschhacker, 2003; Gile, 2009) in a short period of time and often with fairly large classes. One of the skills that interpreters need to master is the ability to expand their vocabulary and content knowledge in technical areas. A primary and largely used method for acquiring technical vocabulary is the creation of personal glossaries. Creating glossaries not only favours terminology acquisition (AIIC, 1999), but is also a way to learn something about the topic itself (Gile, 2002), content knowledge being a fundamental requirement for the interpreter in all interpreting events (e.g. Moser, 1978; Seleskovitch, 1978). A range of existing software programs can be used for creating glossaries, from MS Word or MS Excel (e.g. Fons i Fleming, 2009; Jiang, 2015), to programs specifically developed by or for interpreters and translators, such as Interplex¹, Lookup², and SDL Multiterm³. None of these tools was created for teaching purposes or integrates a learning analytics system.

Within a wider study aiming to provide teachers of interpreting with an integrated system that may support them in their teaching needs, the current paper focuses on vocabulary searches and glossary creation, and describes a recent release of the LearnWeb environment integrating a tool that guides students in the creation of personal glossaries in keeping with the steps and needs advocated and/or described in the literature on interpreting (AIIC, 1999; Gile, 2002; Setton, 2010; Fons i Fleming, 2009; Jiang, 2015). The system also keeps track of the students' activities in the glossary, as well as of their searches on the Web, and provides a dashboard to monitor the student's activities. This system aims not only to support the students in the creation of glossaries, but also to help the teachers monitor the students' approaches to this particular task and provide individual remedial feedback, if necessary. This paper provides a technical description of the environment in which the current tools have been integrated (Section 2) and of the newly developed features (Section 3). As the system was tested with a group of university students specialising in interpreting, the paper also briefly describes this experimentation and reports some students' comments on the advantages and limitations of the current version of the system (Section 4). Finally, some conclusions are offered on the current experiment, and on future developments of the system (Section 5).

¹<http://www.fourwillows.com/interplex.html>

²<http://www.tradutorado.edu.ar/lookup/>

³<http://www.sdl.com/it/solution/language/terminology-management/multiterm/>

2 THE ENVIRONMENT: LEARNWEB

LearnWeb is a learning and competence development environment that allows users to share and collaboratively work on resources collected from the Web or user-generated (Marenzi and Zerr, 2012). It provides users with a search interface for retrieving and sharing resources across various Web 2.0 services, such as YouTube, Flickr, Ipernity, Vimeo, and Bing, as well as LearnWeb itself, and can offer a personal Web 2.0 learning space. The system has been continuously developed at the L3S research center in Hannover, in order to provide a customized environment that supports learners and educators in sharing, discovering, and managing learning resources. The platform is characterised by an iterative evaluation-driven design-based research approach (Marenzi, 2014), i.e. an approach in which researchers and practitioners collaborate in real-world settings to cyclically assess and improve the functionalities of a system (Wang and Hannafin, 2005), tailoring them to the practitioners' needs. The current release of the system provides several innovative features designed to support teachers and students in individual and collaborative learning tasks. These features include:

1. a personal learning space offering a seamless overview of the entire set of learning resources distributed across various Web 2.0 repositories;
2. searching, sharing and aggregation of different learning resources;
3. annotation facilities, such as tagging and commenting, that can help users to discuss and select the most relevant resources for their task;
4. Website archiving;
5. creative production of new meanings (collaborative writing with GoogleDocs; collaborative presentation of learning outcomes with the Presentation Editor);
6. specific functionalities to support educational activities, such as TED talk transcripts annotation (Taibi et al., 2015);
7. automatic logging of the students' actions.

The current release also includes features specifically designed and developed to support the learning activities of students attending a course on interpreting. These features include a tool for the creation of glossaries, a tracking system for logging the students' searches on the Web, and a learning analytics system aimed at improving the efficacy and effectiveness of the processes involved in the creation of per-

sonal glossaries. These features are described in the following sections.

3 DEVELOPING THE GLOSSARY STRUCTURE AND INTERFACE

3.1 Rationale and Structure

The Glossary tool was specifically designed to meet the needs of students of interpreting. The glossary structure was inspired by scientific literature on interpreting (AIIC, 1999; Gile, 2002; Setton, 2010; Fons i Fleming, 2009; Jiang, 2015), and is described below. In LearnWeb, a glossary is a database and is considered by the system as a type of resource, on a par with images, videos and text files. A glossary may host a potentially infinite number of entries. Each entry is composed of at least two terms: the source term and its translation into the target language. Synonyms in the source or target language may be added to a given entry⁴. Thus, depending on the presence of synonyms, each glossary entry will include two or more terms. Each term in a glossary entry is accompanied by a series of attributes, corresponding to given fields in the glossary interface; these enrich the description of the term with optional data. Currently, the glossary is set for the English-Italian language pair, but the interface can be easily adjusted for other language pairs.

Figure 1 shows the glossary interface for entering a new entry. Figure 2 shows a few glossary entries from a student's glossary.

Of the given fields, four are compulsory:

- Topic 1, where the student is invited to select the general topic under which to classify the given terms, by selecting from a dropdown menu; in the current experiment, only one topic was provided: Medicine.
- Description, where the students are invited to enter a short definition or description of the concept that is linguistically realized by the given terms. This field plays multiple roles in the glossary rationale: 1. it is a way to draw the student's attention to the meaning of the terms, rather than the terms themselves; 2. it can be used to retrieve specific terms even when one does not remember them; this field in fact is a searchable text box; 3. from a technical point of view, the Description field is the element that keeps the source and

⁴Synonyms are frequent in technical and scientific language, as pointed out for example by Rogers (2007).

The screenshot shows the 'Add Entries' interface. At the top, there are navigation buttons and a status '(1 of 1)'. Below this is a form with fields for Topic 1, Topic 2, Topic 3, Description, Term, Language, Uses, Pronunciation, Acronym, Source, and Phraseology. Below the form are two sections: 'English Terms' and 'Italian Terms'. Each section has a table with columns for Term, Uses, Pronunciation, Acronym, Source, and Phraseology. There are also 'Add Entries' and 'Add Synonym' buttons.

Figure 1: Glossary interface.

The screenshot shows a table of student glossary entries. The table has columns for Topic 1, Topic 2, Topic 3, Description, Term, Language, Uses, Pronunciation, Acronym, Source, and Phraseology. The entries are as follows:

Topic 1	Topic 2	Topic 3	Description	Term	Language	Uses	Pronunciation	Acronym	Source	Phraseology
MEDICINE	Diseases and disorders		mental disorder that can develop after a person is exposed to a traumatic event	post-traumatic stress disorder	English	technical		PTSD	other	
				Disturbo Post Traumatico da Stress	Italian			DPTS	Linguee or Reverso	
MEDICINE	Diseases and disorders	Signs and symptoms	che si diffonde facilmente ad altri	contagious	English		kanteɪdʒəs		c. disease	malattia c.
				contagiosa	Italian					malattia c.
MEDICINE	Diseases and disorders	Signs and symptoms	patologie causate da agenti infettivi spread by being near to someone	infectious	English	technical	ɪnfekjəs		other	i. disease; cfr. contagious
				infettivo/a	Italian	technical			other	malattia infettiva
MEDICINE	Diseases and disorders	Drugs	drug acting against depression; tipo di psicofarmaco	antidepressant	English	technical	æntɪdɪpresənt		glossary	anti-depressant antidepressant drug, allviate depression; suffer from depression
				antidepressivo	Italian	technical			other	farmaco antidepressivo
				tuberculosis	English	technical	tʃu bəˈkju:loussɪz	TBC or TB	Wikipedia	latent TBC (non symptomatic); active TB; pulmonary TBC; extrapulmonary TBC.
				consumption	English	popular				
MEDICINE	Diseases and disorders		infectious disease of the lungs, causata da Bacillo di Koch	tuberculosis	Italian	technical		TBC	Wikipedia	tbc polmonare; tbc extrapulmonare; TBC latente (o asintomatica); TBC attiva?; TBC resistente ai farmaci
				tisi	Italian	popular			Wikipedia	vedi TBC

Figure 2: Example of student glossary.

target terms, their synonyms and all the other attributes together to form a single entry.

- Term EN, where the student will enter the English term.
- Term IT, where the student will enter the Italian term.

These four pieces of information were thought to represent the minimum amount of information to make up a glossary. The four fields can be filled in any order, but the system will not save the entry if any of them is empty. All the other fields are optional, but each of them was included in the glossary inter-

face for a specific reason. Fields Topic 2 and Topic 3 are meant to help the student to classify the entries according to a logical and functional ontology. In the current experiment, the students were guided in the selection of Topic 2 by means of a dropdown menu containing the following options, inspired by the contents of the module where the experimentation would take place: Anatomy; Diseases and disorders; Food and Nutrition; Medical branches; Institutions; Professions; Other. Topic 3, on the other hand, was an open text box. These fields and menus can be customised to the teachers' needs, upon request. The fields Pronunciation, Acronym and Phraseology are simple text

boxes which accept any type of characters, including IPA (International Phonetic Alphabet) ones. The size of the Phraseology field in the database automatically adjusts to the contents entered into the Phraseology box. This allows the students to use this box freely to enter as many collocations and colligations as they want, but - if necessary - to also enter other pieces of information which have no specific place in the glossary interface, such as part-of-speech information, links to online images and much more. Finally, the Uses and Sources fields are dropdown menus. The Uses menu includes three options (Technical, Popular, and Informal), and is meant to draw the student's attention to linguistic register; there is also the possibility to select all the three options at once. The Sources menu invites the student to specify the primary source of information used to fill in the glossary fields and includes the following options: Wikipedia; encyclopaedia; monolingual dictionary; bilingual dictionary; glossary; scientific/academic publication; institutional website; Linguee or Reverso; patients' websites and blogs; other. This field may seem redundant, given that an automatic tracking feature logs all the students Web searches (Section 3.3). However, it was considered important to make the students think about the type of source(s) they use. Furthermore, it may happen that a student's searches are not tracked because of the student working outside the proxy service, of his refusing to be tracked, or of other technical problems. Finally, at any time the student can delete an existing entry or term by clicking on the red round icon in Figures 1 and 2, or he can modify an existing entry by clicking on the pencil icon in Figure 2. Each student can create one or more glossaries, and each glossary may include a potentially infinite number of entries, i.e. of glossary items. For this reason, search features have also been integrated into the system. The student can filter the glossary by topic, or retrieve a given term by searching for key terms in the description field or by entering the term itself. Furthermore, the 'Search all fields' box allows students to perform text searches in all the glossary fields, thus making it possible, for example, to retrieve all technical terms, English terms only, or specific phrases entered in the Phraseology field. The entire glossary as well as the filtered results can also be downloaded in Excel format (by clicking on the Excel icon) and printed out, if necessary. LearnWeb glossaries can be filled in and consulted bi-directionally (e.g. from English into Italian and viceversa). Furthermore, glossaries can be personal and/or collaborative and can be shared with other students/users. In the current experiment, however, the glossaries were created individually and were not shared.

3.2 Tracking Data for the Dashboard: The Logs and the Proxy

Dumais et al. (2014) give a comprehensive overview of behavioral log data and analysis in HCI. As they point out, "an important characteristic of log data is that it captures actual user behavior and not recalled behaviors or subjective impressions of interactions" (p. 350). Indirect observation methodologies like questionnaires rely on the self-evaluation of students and may not reflect the actual work done by the learners. On the other hand, behavioral observations are increasingly captured at a much larger scale and can be collected in situ on a client machine or on remote servers as people interact with applications, systems, and services. Many studies have already used log data to analyse learning activities (Mazza and Dimitrova, 2004; Zhang and Almeroth, 2010; Mazza et al., 2012). Most of these works utilize only the inbuilt logging facilities of tools like Moodle or WebCT. But many language learning tasks require students to search for information on websites outside the tool used in the course. These external actions cannot be logged by course management systems such as Moodle. Ceddia et al. (2007) used the Weblog Analysis Tool (WAT) application to analyse at activity level the log file data of learners' interactions collected within a Web-based learning environment (a courseware website) in order to gain information about the tasks that the learners had engaged in, and to determine the achievement of educational objectives.

The study by Pérez-Paredes et al. (2011) goes beyond this and uses the log files of a proxy server to analyze which websites students visited to fulfil their task. But this requires a controlled environment, like a classroom, where the course manager can fully control the Internet access or has the privilege to install logging software on the students' computers. Other studies have used screen-capturing software like Camtasia or Adobe Connect to record students' learning activities (Bortoluzzi and Marenzi, 2017). But these recordings have to be analyzed manually, thus the number of subjects is limited by the number of evaluators. Such a method can also be considered more obtrusive than server side logging.

We have developed a novel tracking framework that allows researchers to track all pages a student views during a learning session without requiring changes on the student's computer. Our system tracks also external websites, such as Wikipedia.org or Google.com. Furthermore, it is not limited to classroom use, so students can access it from home and use online resources as they normally would. This makes

Uri	Title	Total events	Created at 
http://it.wikipedia.org.secure.waps.io/wiki/Intestino_tenu	Intestino tenue - Wikipedia	203	2017-03-16 19:09:36.0
http://learnweb.i3s.uni-hannover.de/lw/showGlossary.jsf?resource_id=...	Glossario - Learnweb	3012	2017-03-16 19:08:17.0
http://www.linguee.com.waps.io/english-italian/search?query=small%2...	small intestine - Italian translation – Linguee	186	2017-03-16 19:06:26.0
http://www.linguee.com.waps.io/english-spanish/translation/small%20in...	small intestine - Spanish translation ? Linguee	38	2017-03-16 19:06:18.0
http://learnweb.i3s.uni-hannover.de/lw/search.jsf?query=small+intestin...	Cerca - Learnweb	84	2017-03-16 19:06:13.0

Figure 3: List of all the pages viewed by a user.

Playback: Macrobiotic Food | The Best Macrobiotic Products to Fit Your Diet

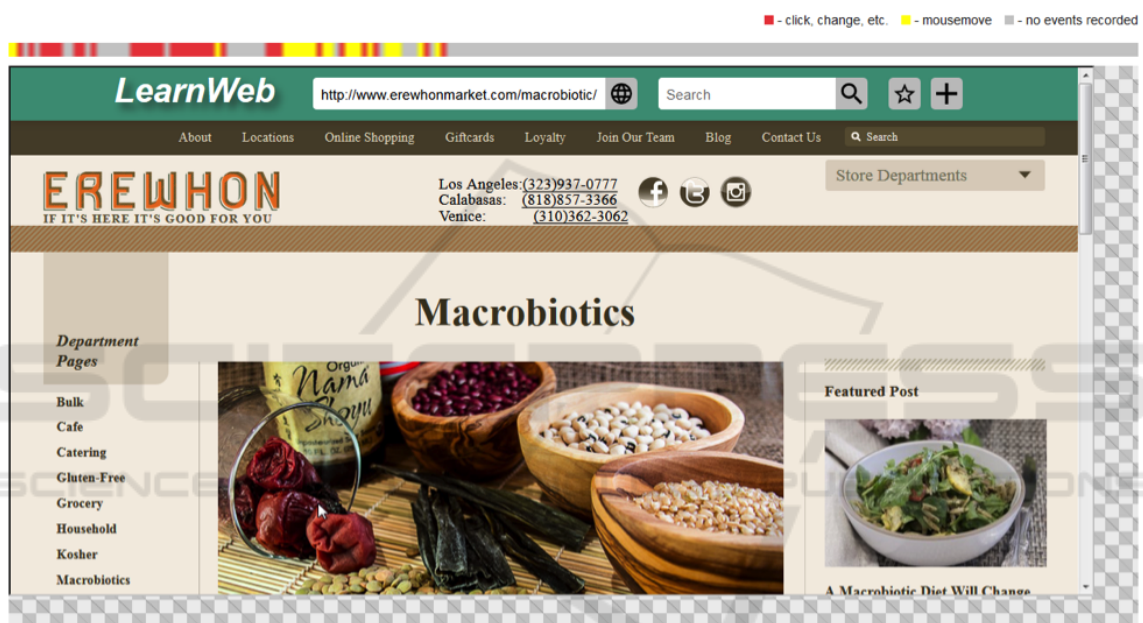


Figure 4: Playback view.

our system very unobtrusive compared to previous approaches. Furthermore, we track mouse movements and keyboard input by users, to detect when they actively interact with a web page. Previous studies did at most take into account how long a user stayed on a website. To this end, they often used a very rough guess, like the timespan between two subsequent web requests. Such a simple measure cannot recognize inactive times (for example when the user has left the computer to get a cup of tea). We call our system Web Analytics Proxy Service and we make it available to other researchers under the domain www.waps.io.

3.3 Tracking Users' Actions

Proxy servers generally create logs that contain simple information, such as the browser model, the URL

and the date when a specific website was visited by a user. Many of the aforementioned studies are based on such data. In order to gather more fine-grained information, we use JavaScript to record all input actions made by the users. This includes mouse movement, scrolling, clicking and typing. We also record when the browser window loses the focus. This happens when the user switches to another browser tab or puts the whole browser window into background. For each input action we record the time and the position on the page.

To limit the log size and the transferred data, we record up to 3 mouse positions per second while the mouse is moved. The log data is accumulated into batches and sent asynchronously to our tracking server; this way the browsing experience is not influenced by the tracker. This data is used to calculate

how active a user was on a page. To this end, we treat all subsequent actions within a sliding window of 5 seconds as one continuous action and assume that the user was active during the whole time-span between the first and last action.

The interface shows all the pages viewed by the user in chronological order (Figure 3). In this particular case, the user first searched for “small intestine” on the LearnWeb platform. Next he opened www.linguee.com and searched for the Spanish and Italian translations of this term. Afterwards he returned to LearnWeb and added his findings to his glossary. Finally, he opened a Wikipedia article.

For each log entry the system can show statistics, including how much time the user spent on the specific site and how long he was active (moved the mouse, scrolled, clicked or typed). It has also the option to “playback” the user’s actions (Figure 4).

For this purpose, the system displays the page at exactly the same window size the user viewed it; furthermore, it can also visualize the mouse movements recorded. At the top, a timeline is displayed showing when the user was active during his session on that page. Yellow indicates that the user moved the mouse, and red that he scrolled or clicked. This timeline is shown only to developers and researchers, not to students.

3.4 The Dashboard

The dashboard is a graphic and interactive representation of the students’ data, based on a selection of log data from the glossary activities. The data were specifically selected to monitor the following: 1. General activity on the glossary task: the dashboard shows general information about the students’ activities (e.g. periods of activity/inactivity; Figure 5), the number of glossary items entered and the number and types of sources (Figure 6); 2. Ability to organize the glossary: the dashboard provides information about whether, to what extent, and how the student completed the compulsory fields and the optional fields; this includes summary and percentage data about the number and types of fields filled in, a list of the descriptions entered and their lengths (Figure 8), and the language used in the description field; 3. Ability to search the Web for information: the dashboard shows the preferred sources of reference as declared by the student (glossary field Source; Figures 6, 7), as well as a list of all the web addresses that were actually opened and tracked by the proxy.

We currently offer a teacher dashboard, and a student dashboard. The teacher dashboard opens on a general view of the group, with particular attention to

the activities on the glossary (Figure 5) and their primary sources of information (Figure 6). The teacher can then zoom in on individual students, by clicking on the student ID, and access similar views of the student activities, as well as views of the student’s ability to organize the glossary, and of his ability to search the Web for information (Figure 7). The teacher can select a given period of time, and all graphs and tables will be updated accordingly. Furthermore, she can filter out specific students from the general group. The student dashboard provides a range of views of the data. It has been designed to allow individual students to view their standing and progress with respect to the group’s average. In the example in Figure 8, small symbols in red, green and yellow indicate respectively if the student progress is under, over or equal to the average of the whole group. These symbols are used not as forms of assessment of a student’s learning progress, but as mere indications of the student’s relative status as regards the task.

4 USE OF THE GLOSSARY TOOL

From 2 March 2017 to 30 May 2017, the LearnWeb Glossary tool was used at the University of Salento (Lecce, Italy) in an MA module training students in consecutive interpreting without notes for the English-Italian language pair. The module focused on medical language. The class included 34 students; of these, 32 were Italian native speakers; 1 was an Italian-German bilingual, and 1 was an Erasmus student from Poland with B2 level Italian. As regards English, they were all B2+ or above.

The students were introduced to the use of the Glossary tool in LearnWeb and instructed to create personal medical glossaries. From the very beginning, the students were informed that the system would track all their actions, as well as all the websites they visited; and they were asked for permission. No one denied permission.

The first few items of the glossary were to be taken from a specific TED talk on medicine, suggested by the teacher, and from other material used in class. This was meant to provide the students with a concrete starting point for the identification of possible candidates for their glossaries. After a couple of hours during which each student created a personal glossary and worked on it in class, the students were invited to continue building up their glossaries from home, as part of their individual preparation for the final exam.

After 20 days, the students were presented with a short questionnaire in order to collect data about the user-friendliness of the platform (9-point Likert scales



Figure 5: Teacher dashboard - Class view of the students' activities.

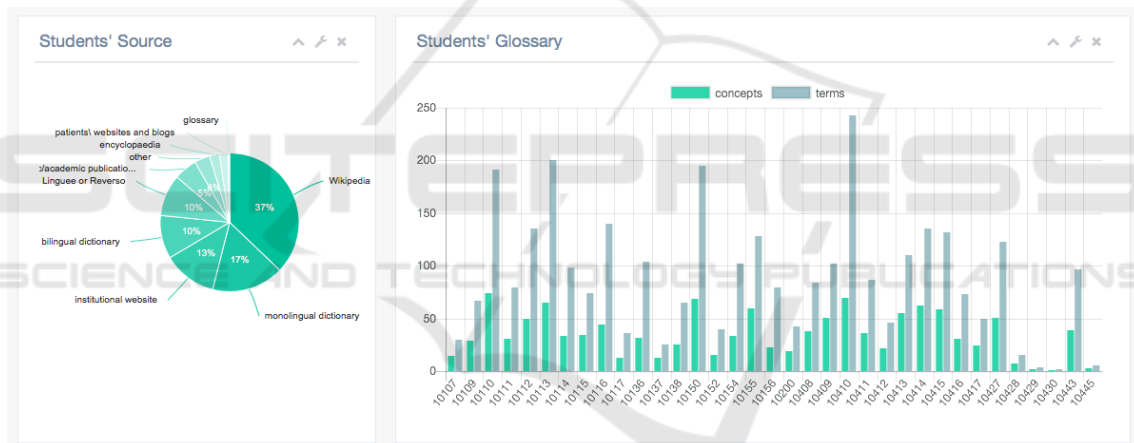


Figure 6: Teacher dashboard - Class view of the students' source of information.

measuring 7 dimensions) and of the Glossary tool (9-point Likert scales measuring 3 dimensions, including the research-by-proxy tracking feature). The questionnaire also invited the students to freely indicate negative and positive aspects of the Glossary, and to add further comments. The questionnaire was created using Limesurvey and was filled in online by the students⁵. The results of the students' answers are summarized in Section 4.2.

4.1 Using the Dashboard to Provide Personalized Feedback

Throughout the course, the teacher monitored the students' activities through the dashboard, and about four weeks after the students started to build the glossaries she had collected enough data to be able to give personalized feedback to the students. In particular, the dashboard showed that a few students were systematically underusing the Phraseology section and/or resorting primarily or almost exclusively to dictionaries as reference resources for the glossary entries. Furthermore, not all students showed the same level of commitment to the task, measured by balancing several indicators, including overall number of fields filled in, number of entries, and number

⁵The template is available at: <http://194.119.209.93:8088/limesurvey2/index.php/148734>

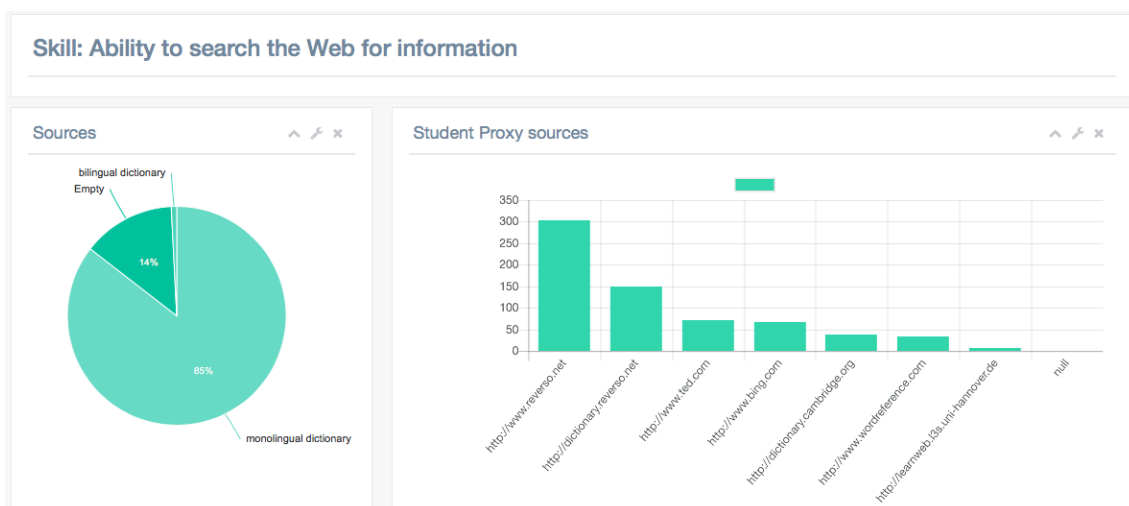


Figure 7: Teacher dashboard - View of a student's ability to search the Web for information.



Figure 8: Student dashboard - Extract.

and variety of sources consulted. Personalized feedback was given by talking individually to the students in need and gradually guiding them to understanding the importance of the fields or types of resources they were disregarding. In the weeks after personalized feedback was given, the dashboard registered change in the behaviours of those particular students.

4.2 Using the Student Feedback to Further Develop the System

According to the data collected with the questionnaires, the glossary user-friendliness was rated fairly high. On a 9-point scale, the average rate was 8 as

regards the easiness to create a new glossary, and 7.5 as regards the easiness to fill in the glossary. Slightly lower (6.5), but still positive, is the average rate of the easiness of searching the Web without exiting from LearnWeb. The platform in general scored on average around 7 in all the dimensions; these were: terrible/wonderful; difficult/easy; frustrating/satisfying; inadequate power/adequate power; dull/stimulating; rigid/flexible.

All in all, the platform and the Glossary tool seem to have been appreciated. The students' feedback to our request to list three positive features did not show a dominant response, but rather clarified that all the existing features were appreciated, by one or another

student, and that the system had stimulated the students to create and expand their glossaries.

Finally, manual analysis of the students' lists of negative points and comments suggest integrating the following features into future releases of the glossary:

1. Adding a field for images.
2. Allowing the creation of glossaries on topics other than medicine.
3. Adding a third language to the glossary, thus making it multilingual, rather than bilingual.
4. Adding the possibility to order glossary terms alphabetically.
5. Adding an explicit indication of the number of entries in the glossary.

Features 1, 2, and 3 had already been planned by the authors of this paper, but could not be implemented before the beginning of the experiment due to time constraints. These will be considered in future releases of the Glossary, along with the other points suggested by the students.

5 CONCLUSIONS

The current paper has described the development and integration of a system for the creation and management of bilingual glossaries into an existing e-learning environment (LearnWeb). This system includes automatic tracking of the students' actions in the glossary, automatic tracking of their searches in the Web while working on the glossary, and a dashboard that analyses the student's interaction with the glossary and displays the results in graphic format for the benefit of both teachers and students. The glossary and the dashboard were specifically developed to support students in the creation of glossaries, and to help teachers monitor the students' approaches to this particular task and provide individual remedial feedback, if necessary.

The system proved user-friendly and highly useful. The Glossary interface stimulated the students to create and expand a personal medical glossary. The teacher dashboard helped the teacher to monitor the student commitment to the study of vocabulary, their understanding of the importance of content and context information, and their Web search strategies; furthermore, it guided the teacher in identifying students in need and in providing personalized remedial feedback. The student dashboard could not be tested in this experiment. The proxy system provided useful information about the students' searches on the Web.

From a research perspective, our experiment has analysed only part of the data tracked and logged by the system. The next steps in the research will include: analysing the time spent by students filling in the glossary and the time spent searching the Web for information, at different times during the experiment; analysing the type of data the students entered in the Phraseology field; and outlining different profiles of student behaviour by means of cluster analysis techniques. These analyses should provide greater insight into student approaches to the creation of glossaries. Finally, further extensions of this project are being envisaged and they include: 1. correlating glossary data to students' exam results; for this purpose, however, data from a much wider number of students should be collected; and 2. asking professional interpreters to use our system and comparing their data to students' data.

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