Je-LKS PEER REVIEWED PAPERS
Vol. 11, n.1, 2015
ISSN: 1826-6223 | eISSN: 1971-8829
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal

A TECHNIQUE FOR DESIGNING GLOSSARY ACTIVITIES WITH FACIAL AUTHENTICATION

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Keywords: e-learning, glossaries in Moodle, facial authentication, online learning, analysis of perceptions

Nowadays, one of the key challenges for distance education is to be able to verify the students' identity in order to check if they are actually who they claim to be when they are doing their online tasks and to avoid identity thief. This can be achieved through facial authentication software. In e-learning, thanks to this technology there is a way to confirm that the students are not committing fraud in their studies and besides to improve this kind of education by equaling its validity and prestige to traditional face-to-face education. The goal of this research is to avoid fake users that perform educational tasks on behalf of others in the Learning Management Systems (LMSs), and more specifically to develop a new technique to design activities with glossaries that properly allow control of the student learning process through facial authentication software. The presented technique is composed of several steps that guide instructors in the elaboration of this kind of activities. This work has used Moodle platform for the experimentation,

for citations:
Guillén-Gámez F., García-Magariño I., (2015), *A technique for designing glossary activities with facial authentication,* Journal of e-Learning and Knowledge Society, v.11, n.1, 125-138. ISSN: 1826-6223, e-ISSN:1971-8829

and analyzes the experience of 67 students with the activities designed with the presented technique.

1 Introduction

Universities are on the path to adapt themselves to the new methods and sources that better adjust to the students' learning. Thanks to the new information and communications technologies (Martin, Diaz, Sancristobal et al., 2011), there is a wide variety of e-learning tools and platforms that help to do online studies. One of them is the Moodle platform (Dougiamas & Taylor, 2003), which has permitted the integration of a wide range of tools such as tests, lessons, wikis or forums (Kakasevski *et al.*, 2008) as means to stimulate and guide the student's daily work. In particular, the focus of the current work is the creation of activities with glossaries.

With the fast rise of these technologies, different techniques of facial authentication (by means of biometrics) have been developed in order to help to verify if people are who they say they are. Jain and Flynn (2008) indicate that biometrics is a method for recognizing people based upon physiological or behavioral characteristics. There are different typologies within biometrics, such as fingerprints, iris, voice, facial verification (García-Hernández & Paredes, 2005). However, the focus is on facial authentication (Farshchi y Toosizadeh, 2011), because with it, an opportunity appears with e-learning (Trombley & Lee, 2002; Toth *et al.*, 2006) to verify students' identities when they are doing their activities within the Moodle glossaries.

A glossary (Hirschel, 2012) is a collection of terms that are relevant for a particular subject, and can be used by students in order to look up information. Glossaries can be exported from a course to another with the Extensible Markup Language (XML), and it is also possible to add links and categories to them. They are accessible through the main menu or through a previously established link from the virtual room. They can be filed by the professor and by the students as well. In this context, Finctumová (2004) affirms that the use of the glossaries with students, give them the responsibility to provide the definitions and this helps them to remember the terms and their right definitions. From the instructors' point of view, the use of the glossaries allows them to present the key concepts of the course and they can be commented by the students.

The purpose of the current work emerges from our previous work (Guillén-Gámez & García-Magariño, 2014) where the investigation was just about the experience in different kinds of activities in Moodle and its plugins. By contrast, the current work proposes a technique that guides instructors in designing glossary activities and is composed of some steps that allow both defining useful activities for the learning process and monitoring them with facial authentication. As experimentation, this technique has been applied for designing two

activities in two different courses of the Open University of Madrid (UDIMA).

In particular, this work has applied the technique with Smowl, which is a facial authentication software described in its website (Smowl, 2014). Smowl is a biometric solution that applies an automatic algorithm in order to validate or analyze people's identity depending on their physiological features. At the beginning of the course, the software captures several pictures of the student and compares them with some reference data as the ID card or passport in order to check his or her real identity. Once these pictures have been taken, these are stored in a database. Along the development of the course, some pictures of the student are taken regularly through his or her webcam, which are compared to those which are in the database through the algorithm to authenticate his or her identity.

As further detailed in our previous work (Labayen *et al.,* 2014), the general structure of the current approach is the following: (1) the software must be placed in the virtual platform of the university (available for different LMS platforms); (2) the university sends a code (an individual identifier for each student) with the image of the student to register in the system. According to the data privacy policy of the system, the software only works with images, not with identities, so Smowl lacks the personal details of students such as name, age or home address; (3) once the student enters in the virtual platform, the system takes a picture which will help in order to create a biometrics model tracker; (4) since then, every time the student is online, the images will be taken randomly and in a continuous way too. Those images will be sent to Smowltech servers, which is located in the cloud, and compared with the biometrics model tracker that has been created previously; (5) the result is doing an up-to-date report of each user in which the university has access to.

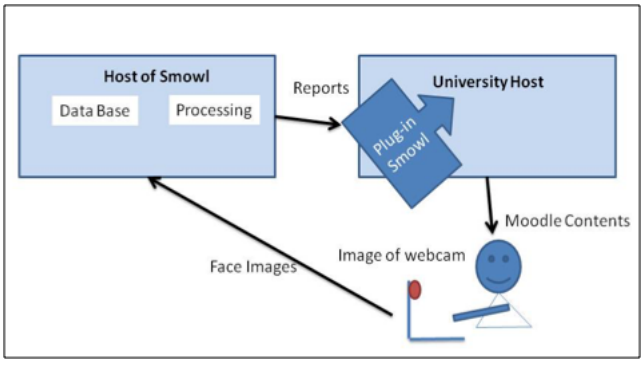

Fig. 1 - Functioning of Smowl

Figure 1 shows how Smowl works. The software is supported by the re-

searches centre Vicomtech-IK4 (2014) which has a wide experience in the visual field by computers. The facial recognition is developed by using the latest algorithms of artificial intelligence, neatly improving the user's face, light problems, position and even how the student looks (physical changes and accessories such as hats, glasses, and so on). It is worth mentioning that the low quality of webcams can slightly reduce the percentage of success in automatic authentication, in comparison with high-definition cameras. However, the students usually already have this type of webcams, reducing the costs of the current approach compared to the alternative of buying new high-definitions cameras for all the students. In addition, students can cheat the system more easily with independent cameras than with the webcams integrated in their laptops. For these reasons, the current approach uses webcams instead of high-definition cameras.

The remainder of this article is organized as follows: the next section introduces the background research related to the current work, mentioning the improvements over the existing literature; section 3 presents technique to design learning activities with glossaries and facial authentication, and introduces the software that has been used for this purpose; section 4 describes the experience that has been conducted with students; finally, section 6 mentions the conclusions, and discusses the future work.

2 Related works

In recent years, new technologies have helped to create several techniques for teaching learning activities. Facial biometrics have been integrated in education and accordingly in e-learning as well. This section is divided into two subsections, first, the discussion about the articles related to educational Moodle Glossaries, and second, the comparison to the works about facial recognition.

2.1 Use of glossaries in the educational field

To begin with, there are different researches carried out with glossaries that have been conducted within the educational field. For instance, Nadiya (2013) suggests the analysis of what a glossary is and how they can be used in the process of making teaching/learning materials. In order to carry out this study, the author used Marine engineer samples. The result was an alphabetical list of certain terms used for: (1) representing the scope of those concepts, facts or personalities studied; (2) gathering the basic terms which belong to a particular field; (3) explaining the most difficult and unknown terms; (4) giving information about historical dates or statistical data; (5) making terminological

units for an activity: matching terms and their definitions; (6) obtaining short descriptions for quick revisions and (7) explaining acronyms and abbreviations

Sinitsa & Manako (2000) carry out a research with the virtual learning environments in which there is a set of tool that facilitate learning, one of these tools is glossaries. These authors state that glossaries provide a cognitive support needed to organize, plan, supervise and assess the autonomous learning. They propose a series of steps to build a hyper glossary as a cognitive tool in order to assist learning process.

Morover, Westerhout & Monachesi (2008) stated that the techniques of processing natural language could be applied to improve the learning process. To achieve this goal, one of the functionalities they developed was a glossary based on candidate detector patterns that allows us to get definitions in eight languages through the learning platform ILIAS. The results showed that there are similar problems among different languages.

Furthermore, Dougiamas (2010) states that glossaries allow students to create a set of text entries and is particularly useful for the development of vocabulary in ESOL (English for Speakers of Other Languages). In addition, Calvert & Szasz (2009) conducted a study with students in which they used Moodle glossaries to track and build new vocabulary. The interactive glossary contained more than a hundred words and phrases that had been found in and out of class which were about sexual transmitted diseases. The glossary provided students the opportunity to review the key vocabulary, but unlike traditional logs vocabulary, online dictionary became a shared resource for the whole class, because it allowed students to learn cooperatively.

In the same way, Filippidi, Tselios & Komis (2010) conducted a research with 117 students who attended an academic course on Moodle. The course was focused on the integration of Information Communication Technologies (ICTs) in education and it is mainly based on problem solving. They analyzed the correlation between the usage of ten Moodle tools and the students' performance. They found that the glossaries were one of the three tools that were actually significantly correlated with students' performance according to the corresponding statistical test. Finally, Marrone, Mantai & Kalyuga (2012) engage students in learning new vocabulary through teamwork and problem solving. To achieve it, they carry out an activity in Moodle glossaries that allows students to learn vocabulary more efficiently, faster and in a more attractive way.

However, if we compare these papers with ours, the main difference is that we provide a technique that assists instructors in designing glossaries on Moodle through facial recognition software. We recommend a series of steps so that instructors can apply the software and consequently students learn easily, quickly and successfully the different content of the glossary, guaranteeing the identities of students.

2.2 Uses of facial recognition tools applied to the educational field

The use of this technology has been under study in a great number of scientific researches in order to improve the educational community, originating different techniques and solving-problem methods.

For instance, Gil, Sancristobal, Diaz *et al.* (2011) describe a new way to verify users' identity in the learning management systems (LMS) used in online education. They tried to integrate a system to verify fingerprints in a LMS called Moodle as a reliable method to get the authentication of users. The system was successfully used with a group of industrial engineering students at UNED (National University of Online Education, in Spain) to get access to their online laboratory tests. In the same way, Hernández, Ortiz, Andaverde *et al.* (2008) describe the use of an online assessment through biometrics recognition systems in a secondary school. For the experiment, a sample of secondary school students (n = 102) was randomly chosen. The authors carried out two assessments; one of them by control evaluation, and the other one by biometrics recognition system. The latter identifies the student through the index fingerprint and monitors the student through webcams during the test. Low scores were obtained through biometrics tests due to the stress because they had limit time and a webcam monitoring them.

Regarding to the use of tools of facial authentication within the educational field, there are several researchers who use the webcam of their students' computers or laptops in their methods to extract images of them in order to verify students or know their mood. In this context, the researchers Grafsgaard, Wiggins, Boyer *et al.* (2013) of the University of North Carolina have carried out a study about facial gestures recognition software, where it is possible to assess in detail the online students' emotions, and predict the effectiveness of online tutoring sessions through webcams. The researchers used an automated tool called Computer Expression Recognition Toolbox (CERT) to assess facial expressions of those university students who took part in those online tutoring sessions. Students (N=65) and tutors interacted through an interface based on web that provided learning tasks. In addition, Lata *et al.* (2009), conducted a study about biometrics in which they focused on the analysis of the main features of face, working with the free software called SciLab. This facial recognition system detects faces of a photograph taken by webcam or digital camera.

In order to identify students when they are doing their online tests, Ullah, Xiao & Lilley (2012) propose a facial recognition mechanism to ensure that students do not do any fraud to get better scores in their online tests. For this reason, a profile based on authentication frame (PBAF), user's identification and a password are proposed to authenticate students during distance tests.

However, Dehnavi y Fard (2011) carried out a system to check students' attendance in online lessons. And this system was used to identify, authenticate and tracking users. Nevertheless, it was not only based on facial features to monitor students, but also in the mouse movements and keyboard dynamics. The justification stated to use not only the facial student features is that a system has one biometrics feature which could cause difficult problems to solve, Due to this, different biometrics features were used to verify students.

However, in the biometrics field we should underline the work of González-Agulla, Rifón, Castro *et al.* (2010) because they proposed a solution to get useful and reliable session registers of students in a LMS. The aim they were looking for was to guarantee online students verification, and to know in detail how long they have been reading or doing online tasks. Even when the given solution did not avoid the student's fraud; the use of biometrics methods during authentication and monitoring their face proposed extra help to check student's output during learning sessions. This ensures the possibility to obtain students' feedbacks and check in real time what they use during the learning process. The research done with students had three parts: (1) the student checked the position of the webcam which was on the computer screen to create the account using the verification module; (2) the student did a brief questionnaire of seven questions using Moodle; (3) the student moved to the computer on their left and used that computer in order to carry out another questionnaire; (4) the students returned to their computer to check the results in both questionnaires using Moodle.

If we compare these projects with ours, the main difference is that we based ourselves on the use of biometric technologies specifically in glossaries, within Moodle, in order to assist teachers and instructors to install a facial authentication tool in their classes and design adequate learning activities with a proper biometrical control mechanism.

3 Technique for using Smowl with glossaries

Teachers tend to create glossaries adding concepts of the course in order to assist students during the learning process, and thus, learning any subject may be easier through its main concepts. A glossary might be a good starting point to build knowledge for most cases. Defining concepts is a cognitive capacity that must be worked accurately by learners depending on their stages. These glossaries offer teachers a variety of ways to use them in their subjects, ranging from qualified entries if glossaries were assessment activities, to review and acceptance of inputs by the teacher before entries are posted.

Instructors who decide to carry out this technique must acquire the use rights of Smowl so as to perform facial authentication of students. By doing this, they prevent fraud when evaluating students' activities, since it is possible that some students could ask other people to do activities for them, or even perform activities in groups. Even when the proposed solution does not completely prevent student from cheating, the use of biometric data during authentication provides extra help to validate the performance of the student during the learning sessions.

The presented technique guides instructors in designing glossary activities with facial authentication, and is composed of the following steps:

1. Write the instructions for students and upload these in Moodle.
   Create an instruction sheet with learning objectives that students must achieve and description as conducting activity. In addition to this, report deadlines.
2. Create a new glossary in Moodle, and configure it.
   Create and configure the glossary according to the objectives of the activity. It should be set deadlines and a rating category from: (1) learning activities, (2) continuous assessment activities, (3) no assessable activity or (4) test.
3. Contact the company for the service. Contact and hire Smowl service so that its software can be installed in Moodle tool.
4. Insert facial recognition in the glossary activity. The company that created the software Smowl inserts it according to the preferences of the instructors: random time to be monitored, number of pictures captured.
5. Introduce students in facial authentication if it is their first time. Instruct students in carrying out student settings in the system to capture three images of each student and keep them in the database in order to compare these photographs with the new ones that will be taken during the conduct of their activity.

The main step is to write the instructions of the activity for students. These instructions are recommended to have the following generic steps that can be particularized for each subject:

1. Study the corresponding units of the subject, and search information about the terms that you do not understand, until you feel confident about the contents of the units.
2. Make sure your webcam works properly. Be sure that it is properly installed so that the software can capture pictures.
3. Make sure that nobody will interrupt you in the next 30 minutes. You must be just doing online tasks while the software is checking on you.

4. Click on the glossary link within the Moodle virtual room
5. Accept the conditions of facial authentication if you agree. In this way, you accept the terms of Smowl that permits the capture of pictures from time to time.
6. The authentication software will automatically start until you finish this activity. The software will capture photographs from time to time while the student is doing their homework.
7. Read the terms that have already been defined by other students. Read the activities that your peers have done in order not to repeat the same terms in the glossary. Furthermore, students will have the chance to learn or remember the concepts that have been written by their peers.
8. Write the definition of two terms that are related to the units of the subject and have not been defined yet. For each term, you must type the definition with your own words without copying it literally. Be accurate and concise. Revise each definition before its final post in the glossary.
9. Finish the activity by exiting the glossary, so that the facial authentication system will stop working. Once a student has completed their activities, the software will stop capturing images. These images are stored in the company's servers where they are analyzed in order to identify students.

During all the time that the face authentication system can monitor the user, all biometric information captured is stored in the user history. The authentication and monitoring are made to recognize facial characteristics of users. The course will work as usual, the only difference is that Smowl will randomly capture photographs of students through the webcam of their computers while they are working in the virtual classrooms. Furthermore, instructors may choose time frequency for monitoring students.

The results will lead to a report which will be constantly updated with information about each student where the university will have access so as to track student authentication. Moreover, neither the university nor the company that created the software will have access to personal student information, because images take a bar code issued by the university for each student. That is to say, the software will make the resulting report available for the university, but not the pictures of students.

In Figure 2, one can observe the control panel of Smowl, in which the teacher has access to observe the tracking of students. For instance, this figure shows how out of the 20 images that the software took of a student, the 68.67% of them were the correct user. As for images that do not pass the test, <Smowl> classifies different scenarios, such as (1) the student refused the permission to activate the webcam, (2) the web camera is covered or not working properly, (3)

there were several people and none of them is the correct user, (4) there is more than one person and one of them was the right user, (5) the person in the photo is not the user who claims to be, and (6) there is no one in front of the screen.

T_M05_2013	WebCam rejected		WebCam on but covered		+ one person: none the correct user		+ one person: one is the correct user		Another person		Nobody in front of the screen		Correct user	
Total	0	0%	0	0%	0	0%	0	0%	2	6.67%	8	26.67%	20	66.67%
1	0	0%	0	0%	0	0%	0	0%	2	6.9%	7	24.14%	20	68.97%
2	0	0%	0	0%	0	0%	0	0%	0	0%	1	100%	0	0%

Fig. 2 - Values of student results for periods of time.

4 Experimentation

In order to experience this technique, two activities were designed following it in two different courses: (1) 'Advanced techniques in E-Learning' from the Master Degree on Education and New Technologies, and (2) 'Technological Platforms' from the Master Degree on Digital Communication. These activities were experienced by 67 students in UDIMA, and they were surveyed afterwards in order to evaluate the technique.

These two activities were designed following the presented technique, and were particularized for the specific subjects. Specifically, these two glossary activities asked students to define two glossary entries about two tools either with which they have worked for other activities in the virtual rooms or which are mentioned in the subject manual. Each of these entries is required to have three sections: (1) a brief description of the tool that the student has chosen, (2) the most relevant characteristics about the tool (positive and negative aspects), and (3) the didactic use the student would give to the tool in an educational environment. Each entry is required to have an approximate size of a page (about 500 words). Afterwards, the entries were reviewed and evaluated by the instructor.

In order to evaluate the experience with the presented technique, several questions were designed to evaluate the experience of students with the corresponding activities with Moodle glossaries using face-based authentication. Students responded these questions with a seven-point Likert scale with the following grades: totally disagree (1), disagree (2), slightly disagree (3), neither agree nor disagree (4), slightly agree (5), agree (6) and strongly agree (7). It

took several hours for each student to perform the corresponding activity. Once students have finished, they had to answer these questions, which are included in the caption of Figure 3.

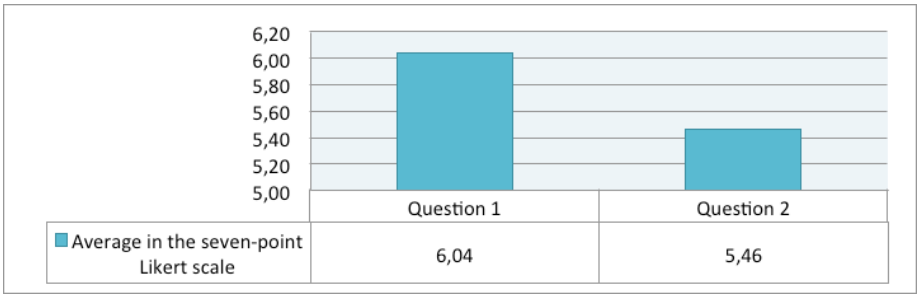

Fig. 3 - **Question 1**: Do you think it is appropriate to apply facial authentication in a Moodle glossary when it is a marked activity? **Question 2**: Do you think that the experience you have had with the glossary and facial authentication is positive for your learning?

Figure 3 shows the averages of the responses to the two questions, which are 6.04 for the first one and 5.46 for the second, out of 7. Having the seven-point Likert scale in mind, the students think that facial authentication is appropriate for the Moodle glossaries when these are used for the evaluation, being in the range of "agree" in Likert scale. Nevertheless, when the students are asked if their experience with the glossaries has been positive, the average in Likert scale is slightly lower if it is compared to the other question from Figure 3, although it keeps a positive range in Likert scale with a grade between 5 "slightly agree" and a grade 6 "agree". Hence, students think that it is suitable to use facial authentication in this Moodle module, even though they still are reluctant to the use of it with themselves. On the whole, the application of this technique has been successful, and the students evaluated the activities designed with the presented technique as positive in general.

Conclusions and future work

The current work has presented a technique for designing activities with Moodle glossaries and facial authentication. On the one hand, students benefit from the use of glossaries for learning concepts and present these to their peers. On the other hand, this technique improves the quality in distance education, preventing possible frauds of students in evaluative activities using facial authentication software. Even when the proposed solution does not completely prevent student cheating, the use of biometric data for authentication and face

tracking provides additional help to validate the identity of students. As experimentation, this technique was applied to define two activities in two different courses, and these were experienced by 67 students. They considered positive their experience with these activities, and appropriate the use of facial authentication in evaluative glossary activities.

The research is planned to be extended to other Moodle modules and plugins, in order to provide specific techniques for designing different kinds of activities with facial authentication. Moreover, the current work will continue with the test of usability in search of an improved user experience with facial authentication within Moodle. Furthermore, the current experimentation is expected to be enhanced with a larger number of students and more questions, conducting these experiments with more subjects, in order to corroborate the results of this work and to improve the technique if necessary. These analyses are planned to include parametric statistical tests to determine whether some differences are significant or not. Finally, the current approach is planned to be compared with other verification algorithms with some publically available databases, to assess the accuracy of the facial authentication system.

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