

D4.2 Second Version of Human-Computer Interface



Partner Responsible	AthenaRC
Other Contributors	UTH-SED, UTH-ECE
Document Reference	D4.2
Dissemination Level	Public
Version	1.0 (Final)
Due Date	February 2023 (M37)
Date of Preparation	February 2023

Contract No.: HFRI-FM17-2456



ATHENA Research & Innovation
Information Technologies

Editor

Stavroula-Evita Fotinea (**AthenaRC**)

Contributors

AthenaRC: Stavroula-Evita Fotinea, Eleni Efthimiou, Theodor Goulas

UTH-SED: Galini Sapountzaki

UTH-ECE: Katerina Papadimitriou, Gerasimos Potamianos

SL-ReDu Principal Investigator:

Assoc. Prof. Gerasimos Potamianos

University of Thessaly, Electrical and Computer Engineering Department (**UTH-ECE**)

Volos, Greece 38334

email: gpotamianos@uth.gr (gpotam@ieee.org)

Executive Summary

The SL-ReDu project aims to advance the state-of-the-art in the automatic recognition of Greek Sign Language (GSL) from videos, while focusing on the novel education use-case of standardized teaching of GSL as a second language. In this deliverable (D4.2), we present the second version of the SL-ReDu human-computer interface (HCI), as designed and implemented within the ongoing effort towards the release of the second version of the SL-ReDu prototype system in WP5 (upcoming Deliverable D5.5). The implemented HCI comprises an enhanced version of the one reported in Deliverable D4.1 incorporating: (i) necessary improvements resulting from end-user comments and experience during the evaluation of first system version (Deliverable D5.4); (ii) extensions that reflect the advancements in SL recognition technology as a result of research within SL-ReDu and the extended linguistic content that the second version of the prototype system will accommodate; and (iii) new interaction features completing the platform design so that it also addresses the educator end-user needs for creating teaching and testing materials. D4.2 incorporates all language material of WP3 in its entirety, while it features appropriate dialog management strategies and exploits SL recognition technology along with text, icons, video and synthetic signing for a complete educational interaction of the user with the platform. The deliverable is part of the third project milestone (MS3).

Table of Contents

Executive Summary.....	3
1 Introduction	5
2 The Designed Interface.....	6
2.1 Initial Web-Based HCI Page	6
2.2 User Accounts.....	8
2.3 Content Presentation	8
2.4 User Scoring	9
2.5 Teacher / Administrator Interaction Options.....	13
3 Conclusions	15
References	16

1 Introduction

Designing an interactive human-computer interface (HCI) for second language (L2) learning, exercising, and testing represents a relatively recent trend in the sign language (SL) literature [1-3]. Compared to traditional spoken languages, the task faces additional methodological and technical challenges for SLs [4-7]. For example, self-monitoring and testing in SL as L2 require exploitation of video and image streams to build interfaces for both passive and productive language exercising. In addition, while creation of exercises to test comprehension and understanding of language elements is a relatively well-implemented task, active learner participation in SL performance introduces a completely innovative aspect in SL learning. To accomplish this task, the learners are required to create and upload their own videos of linguistic performance and provide consent to have these videos feed an SL recognition engine.

Based on earlier SL-ReDu Deliverable D3.2 [8], the design of the platform interface for the project has opted for a user-friendly and straightforward environment as already designed and reported in Deliverable D4.1 [9] and incorporated in the first SL-ReDu prototype version (Deliverable D5.3 [10]). The goal has always been to provide a platform that incorporates easy-to-use user-centric functionalities and user-supporting features, which can be run by the student equipped with a suitable computer and camera. From the educational content point-of-view, the self-monitoring and assessment modules of the platform needed to incorporate the complete curriculum of GSL learning at levels A0-A1. This means that, in line with the design of the platform system architecture that has been discussed in Deliverable D5.2 of WP5 [11], all user interaction patterns needed to be taken into account to effectively accommodate the educational content. The variation in user interaction patterns is also necessary when the tutor is setting together a new test, since the latter needs to be drawn from a large pool of available candidate exercises, in line with the accredited SL curriculum, as suggested by the Common European Framework of Reference for Languages (CEFR) [12]. The aim has been to design a platform interface which successfully addresses the needs of a large population of students objectively and accurately [13], but it also covers the educators' needs for creation of testing materials and student monitoring.

Deliverable D4.1 [9] reported on the first phase of work on Tasks T4.1 and T4.2 of WP4, which combine the design of the platform's HCI features with the various interaction modes which are required to successfully perform the self-monitoring and assessment tasks in the SL-ReDu platform. Here, we extend that work, presenting a complete set of HCI features that have been implemented as part of the upcoming second version of the SL-ReDu platform (upcoming Deliverable D5.5). Specifically, we have incorporated design improvements, which have been indicated as a result of the first end-user evaluation cycle (Deliverable D5.4 [14]), while it also entails the whole volume of the foreseen educational materials, providing a complete educational tool for the A0-A1 GSL levels and beyond in parallel with a tool that enables the educator to create testing materials and monitor individual learners' progress.

2 The Designed Interface

As defined in Deliverable D5.2 [11], which reports on technical specifications and system architecture, and already mentioned in Deliverable D4.1 [9], the SL-ReDu platform is hosted by an Apache Web Server. A MySQL database is used to store all educational material and exercises, as well as user progress and performance statistics, based on information exchanged between the user and the web server while executing the assignments. The web application is designed to incorporate a camera module to record user performance whenever required, with the submitted user recordings sent to the SL-ReDu recognition module.

In the sections that follow, we adopt the structure of Deliverable D4.1 [9] in order to report on the user interface and functional enhancements incorporated in the second version of the SL-ReDu system HCI implementation. Indicative screenshots exhibit both the adopted HCI approach and the added functionalities, aiming to illustrate changes in previously implemented and evaluated aspects of the platform, along with new platform features with emphasis on the design for educator-platform interaction.

2.1 Initial Web-Based HCI Page

The “landing” page of the SL-ReDu platform (shown in Figure 1) has been redesigned with incorporation of a parallax scrolling effect, following suggestions by end-users as collected during the evaluation of the first system version (Deliverable D5.4 [14]). The page has also been enriched with widgets providing system-use related information at the moment of reaching the “landing” page (Figure 2). Widgets inform the user about the precise number of registered users, the number of the examinations that exist within the application, the number of the already performed tests, and the amount of the study materials within the application. Another new feature is the option for the users to post their comments (Figure 3). User comments are stored to a proper table in the system database.



Figure 1: “Landing” web page of the designed SL-ReDu HCI.

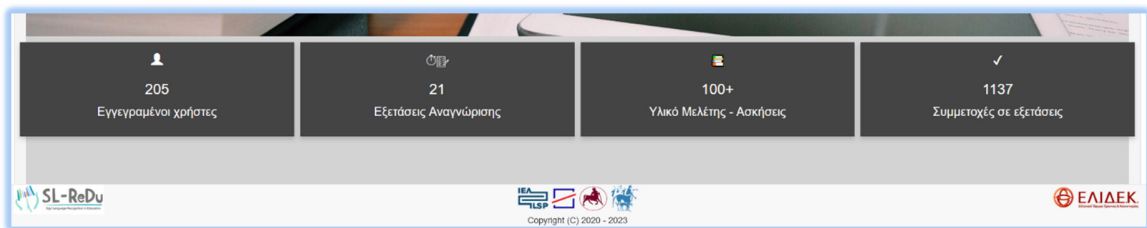


Figure 2: System-use related information available at the “landing” web page.

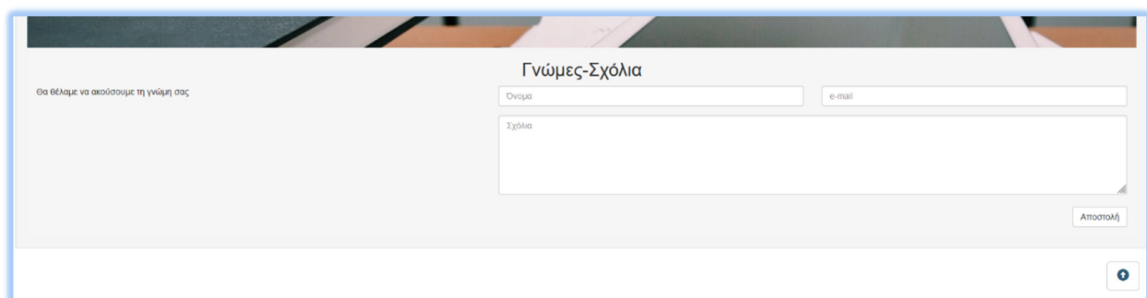


Figure 3: User comments domain at the “landing” web page.

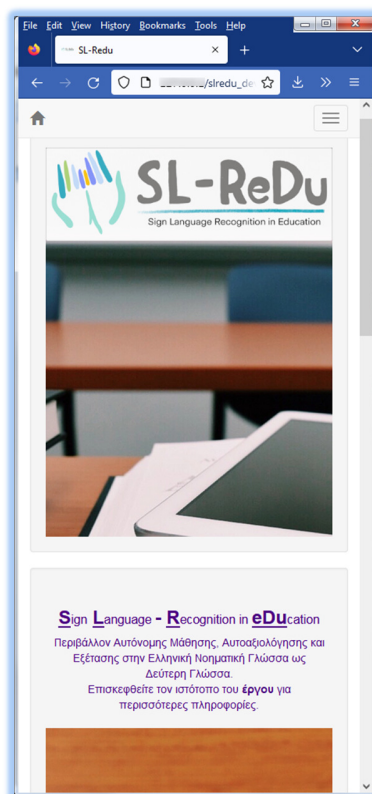


Figure 4: Initial SL-ReDu page in mobile view.

Furthermore, a number of style sheets (*.css) from the previous version (Deliverables D4.1 and D5.3) have been removed and replaced by advanced ones so that the application becomes fully responsive (see also Figure 4 for the platform mobile view). Finally, changes have also been made to the footer of the application. Links have been added to the logos in the footer, which redirect the user to the clicked partner's web site.

2.2 User Accounts

The two different types of users (instructors and learners) can either sign in (for the first time) or revisit the platform by simply logging in, as already described in Deliverable D4.1.

2.3 Content Presentation

In this section, we report on the design features and functionalities implemented in the second version of the SL-ReDu HCI. These entail replacement of videos of relatively lower resolution with ones of high resolution. Additionally, background images have been added to each exercise.

As an example, the following images depict the *numbers recognition* test (test1) before the start of the test while choosing the difficulty level (Figure 5(a)), and while starting the test (Figure 6). The yellow box, which accommodates the instructions for the execution of the exercise, can be closed by clicking the “X” button, located at the top right corner of the yellow box (Figure 5(b)).

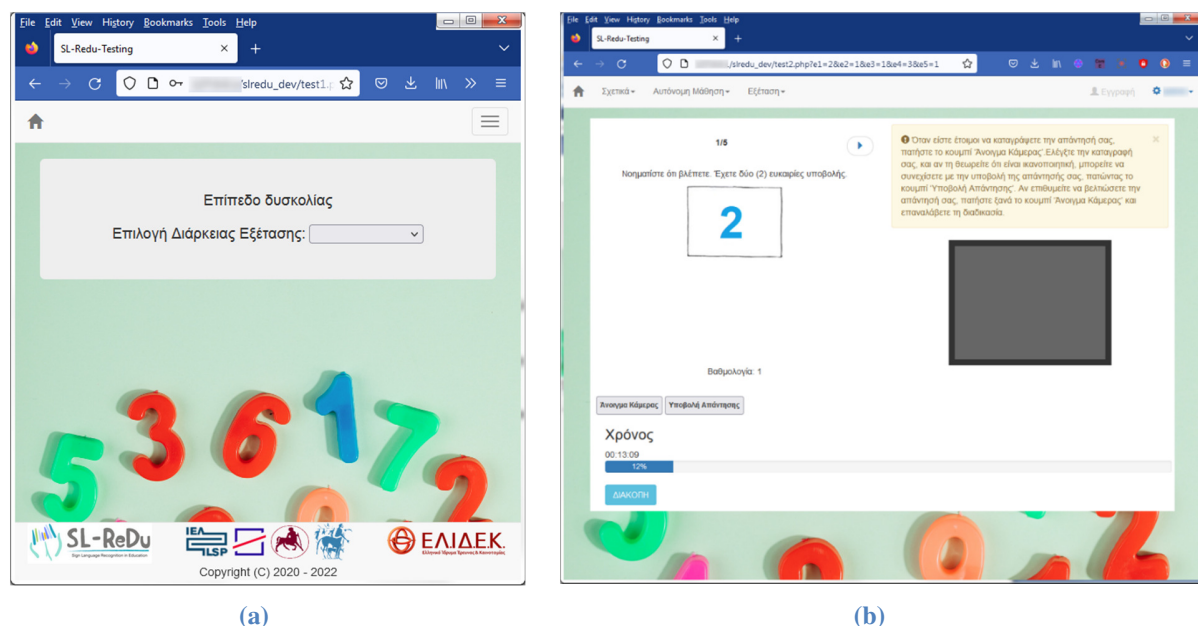


Figure 5: Example of numbers recognition exercise pages: (a) Choosing the difficulty level; (b) Exercise execution.

In general, the appearance of the study material that is provided under the menu “autonomous learning” has been changed as in Figure 6. The side menu can appear or disappear on demand. In this way, the page remains fully responsive and offers more space for the material presented to the user.

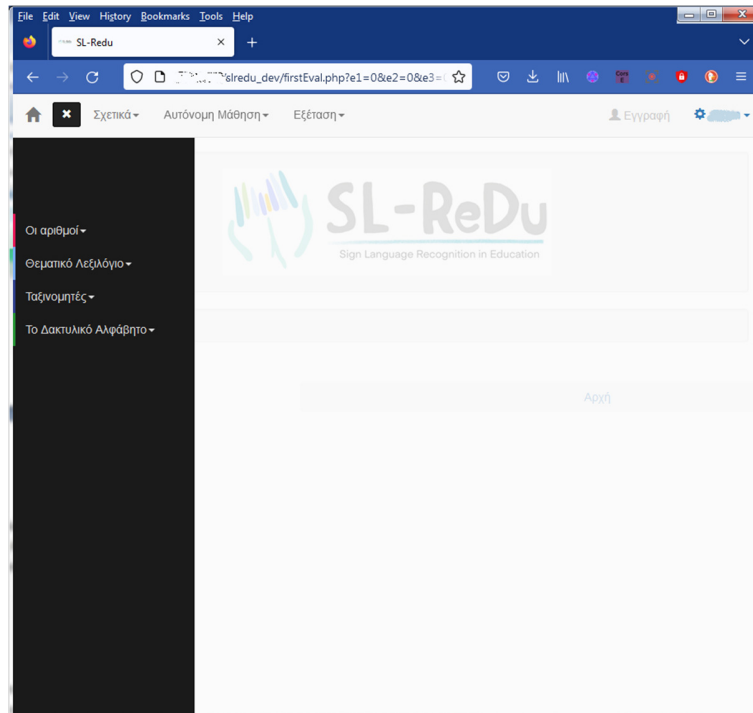


Figure 6: New version of the autonomous learning section material presentation.

2.4 User Scoring

One of the changes regarding system functionalities is the way users get and can view their scores. In the previous system version (first version), the user score was stored as a variable and was being altered throughout the tests performed by every specific user. At the end of each test, the updated variable with the cumulative score reached by the user was stored in a proper table of the database.

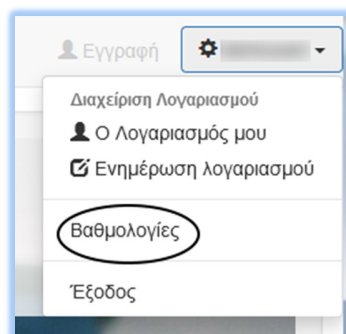


Figure 7: Access to the exam scores.

In the second system version (forthcoming Deliverable D5.6), after every user response the score will be stored in the score tables of the database and will be updated by every new user response till the end of the test. Thus, while in the previous system version the users knew only their overall score regarding completed exercises or the taken test, now there is a special page available where the test scores are stored and can be accessible via the “scores” option of the admin menu (Figure 7). Additionally, the performance of a user while taking a test can be followed since the score of each individual reply is also stored in a user performance table of the database.

Βαθμολογίες Χρήστη: ██████████

Σελίδα εξέτασης	Διάρκεια εξέτασης (min)	Βαθμολογία	Συνολική Βαθμολογία εξέτασης	Ημερομηνία Διεξαγωγής
testnumb.php	0	4	8	02-12-2021 20:06:36
test4.php	0	0	3	08-12-2021 14:58:01
testnumb.php	10	9	8	13-12-2021 17:40:18
test3.php	6	0	3	13-12-2021 18:14:20
testnumb.php	15	8	8	22-09-2022 11:40:13
testnumb.php	10	0	8	22-09-2022 11:48:52
testnumb.php	10	0	8	22-09-2022 11:49:01
testnumb.php	10	8	8	22-09-2022 11:50:10
testnumb.php	15	0	8	22-09-2022 11:59:09
testnumb.php	15	0	8	22-09-2022 11:59:48
testnumb.php	15	0	8	22-09-2022 12:01:57
testnumb.php	15	1	8	22-09-2022 12:02:38
test1.php	18	0	0	22-09-2022 12:45:24
testSignRecog1.php	18	0	6	23-03-2022 19:50:02
testSignRecog2.php	18	0	6	23-03-2022 19:50:23

SL-ReDu
Copyright (C) 2020 - 2022

Figure 8: List of tests performed by a particular user, showing test scores, durations, and dates taken.

To allow the users to better monitor their progress, the system now creates more tables, where user performance is captured. One such table allows users to have access to the tests they have completed (Figure 8). Clicking on a selected link of those listed in the column “test page”, the user is redirected to the performance information table connected with this specific test, as depicted in Figure 9. As shown there, the user can check the answers provided. In case of a wrong answer, the score for the related question appears as zero (0). Colored buttons in the column “Test Question” indicate wrong (colored red) and correct (colored green) user response. By pressing any colored button, the related question will appear on an auxiliary window.

Βαθμολογίες Χρήστη: ██████████

Show 10 entries

Σελίδα εξέτασης	Exercise ID	Βαθμολογία	Ημερομηνία Διεξαγωγής	Ερώτηση Εξέτασης	Συνολική Βαθμολογία εξέτασης
testnumb.php	2	1	30-08-2022 11:31:42	Show	1
testnumb.php	3	0	30-08-2022 11:31:44	Show	1
testnumb.php	4	1	30-08-2022 11:31:48	Show	1
testnumb.php	5	1	30-08-2022 11:31:50	Show	1
testnumb.php	6	0	30-08-2022 11:31:52	Show	1
testnumb.php	7	0	30-08-2022 11:31:55	Show	1
testnumb.php	8	1	30-08-2022 11:31:57	Show	1
testnumb.php	9	1	30-08-2022 11:31:58	Show	1

Showing 1 to 8 of 8 entries

Previous 1 Next

SL-ReDu
Copyright (C) 2020 - 2022

Figure 9: Performance table providing the history of the user responses for each exercise of a test.

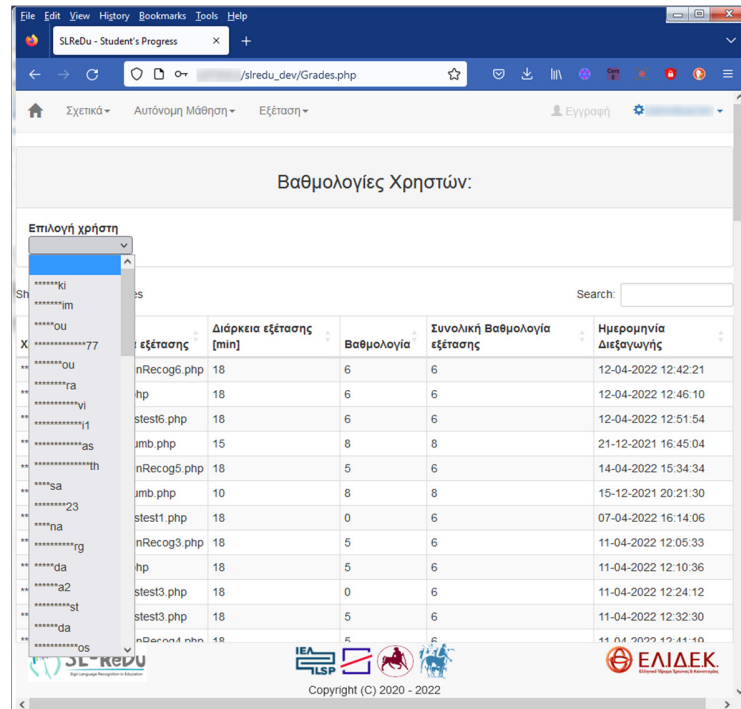


Figure 10: Performance of all users, visible to the instructor (actual user login names appear masked).

Users with teacher (instructor) rights have access to the scores of all users. Through a proper search option, a teacher can look up the scores of any chosen user. It is worth mentioning that the names of users appear masked, both in the table and in the search drop-down menu (Figure 10), so the user remains anonymous.

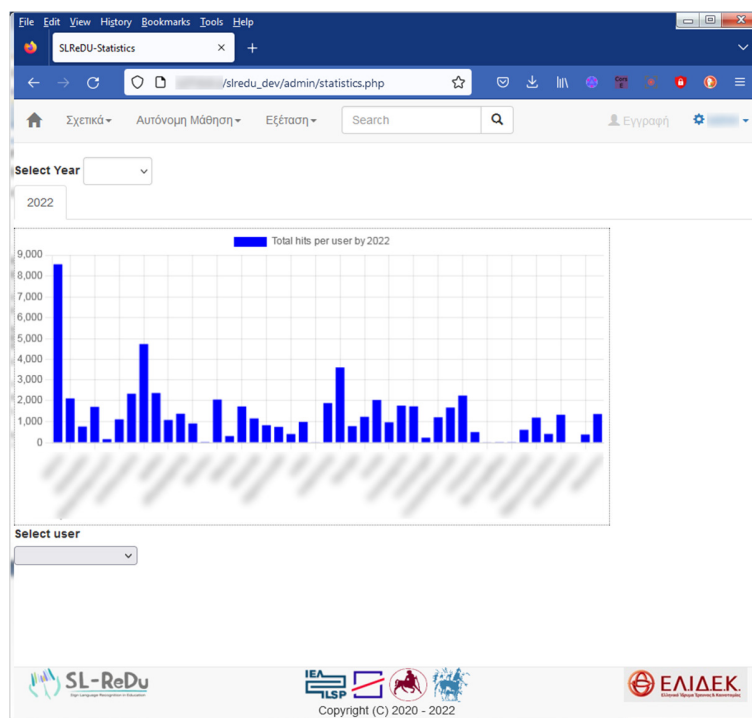


Figure 11: Diagram summarizing user platform activity.

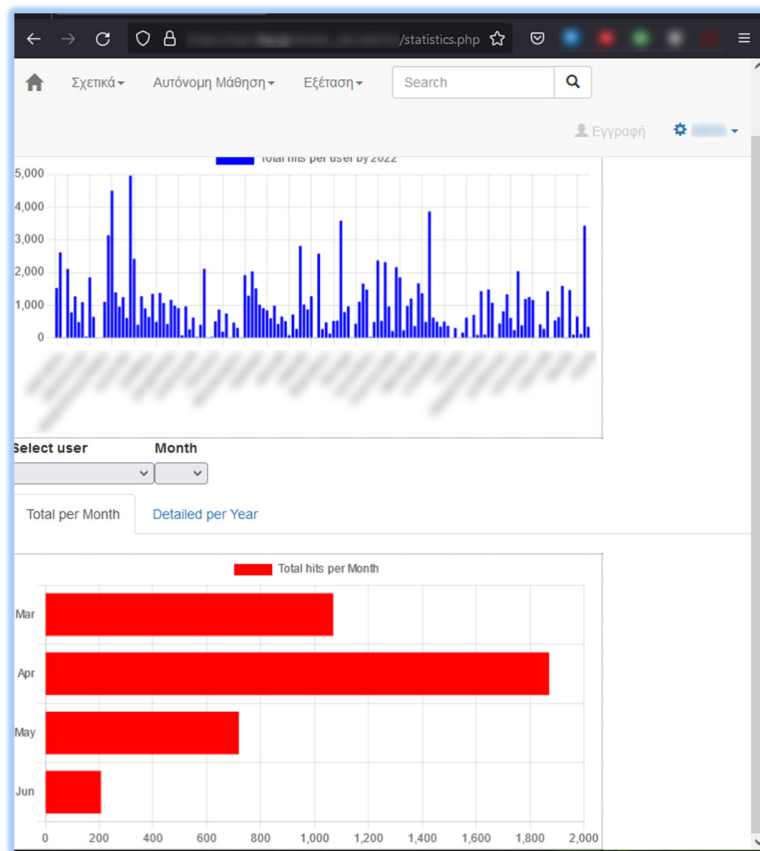


Figure 12: Detailed user activity on the platform per month.

On the administrative part of the application, where only the administrator has access, diagrams have been added to track user activity. Diagrams are created dynamically. Access to the diagrams is possible through the interface, where according to the user rights, the menu provides different options. Figure 11 depicts how the administrator can view the frequency with which the platform pages are visited by users. If it is desired, it is possible to look up user activity in more detail as shown in Figure 12. Finally, access to user comments, provided as an HCI option in the “landing” platform page (Figure 3) to them, is possible through the administrator menu (see Figure 13).

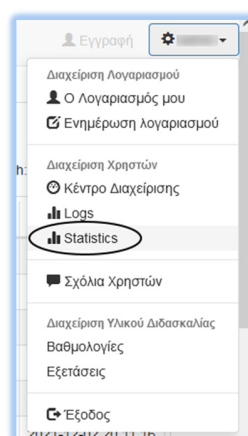


Figure 13: The administrator menu.

2.5 Teacher / Administrator Interaction Options

One major addition to the SL-ReDu system is the set of facilities available to the teacher/administrator, which enable full control of student performance and creation of tests according to specific educational needs.

Along with the options to view and control individual student scores and performance, as already depicted in Section 2.4 above, users with teacher rights, as well as the administrator users, are able to create new test-exercises by employing a user interface dedicated to this purpose and accessibly only to users with the specific access rights.

The steps a teacher needs to follow to create a new test are presented next:

- The teacher needs to click the tab “New Test” in the administrator environment (Figure 14).
- As a result, the auxiliary window in Figure 15 will appear, which allows for the definition of the test type and the number of questions to be included in the specific test.
- The user must go through the wizard to create a new test and the included exercises. The test will be assigned a name automatically according to the selected test type; i.e., all sign-recognition tests have the script name “testSignRecogXX” where XX is a number. The newly created test will then be named “testSignRecogYY” where YY is the number XX of the script each time increased by 1. The same pattern applies for the selection of the questions included in the test.
- The newly created test will then be stored in the database, and all relevant tables will be updated automatically.

Finally, users, with teacher/administrator rights have the possibility to manage all the previously created tests, including the option of deleting any that are not needed any more (Figure 16).

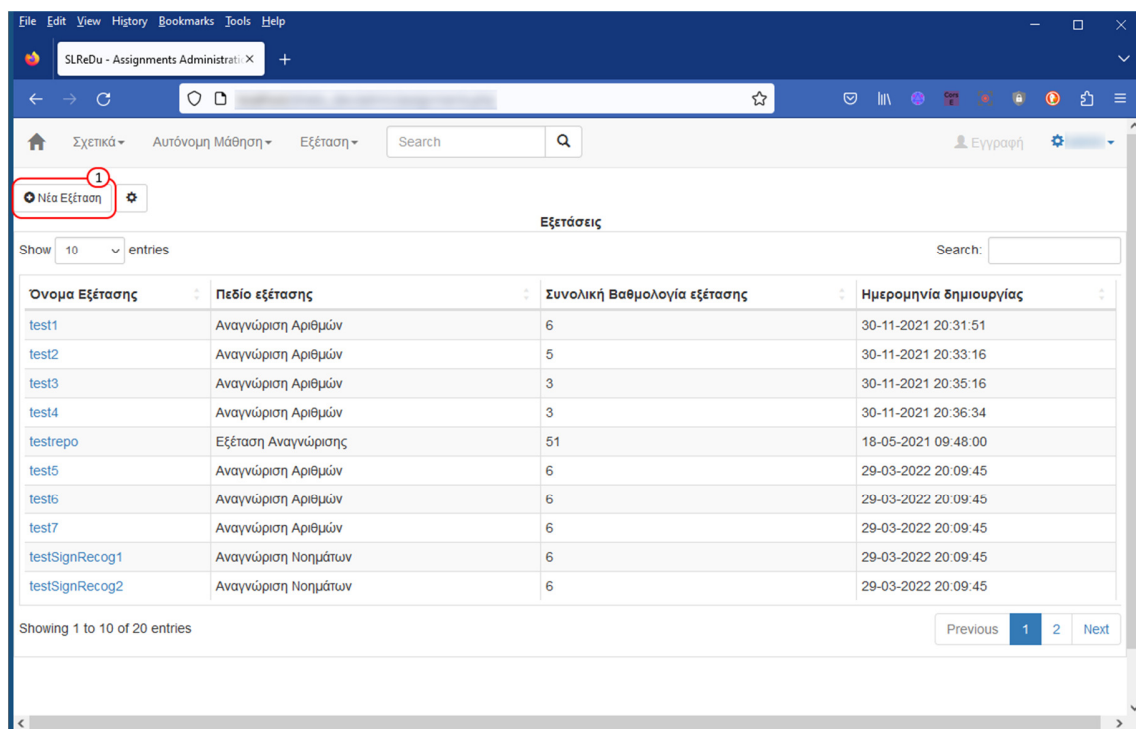


Figure 14: Initiating the creation of a new test.

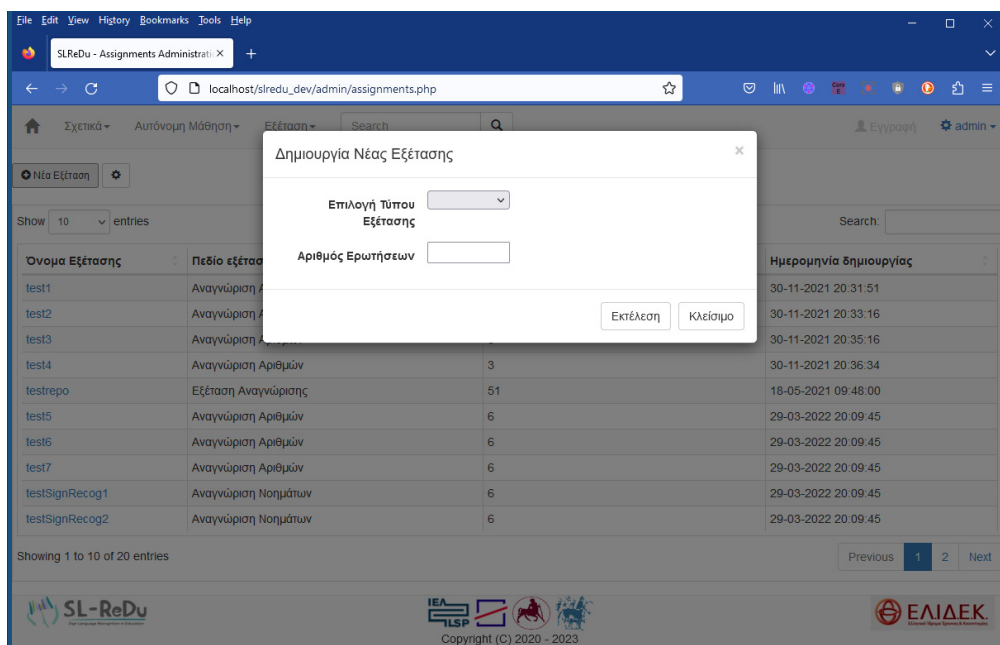


Figure 15: Dialog window enabling test type selection and number of questions included to it.

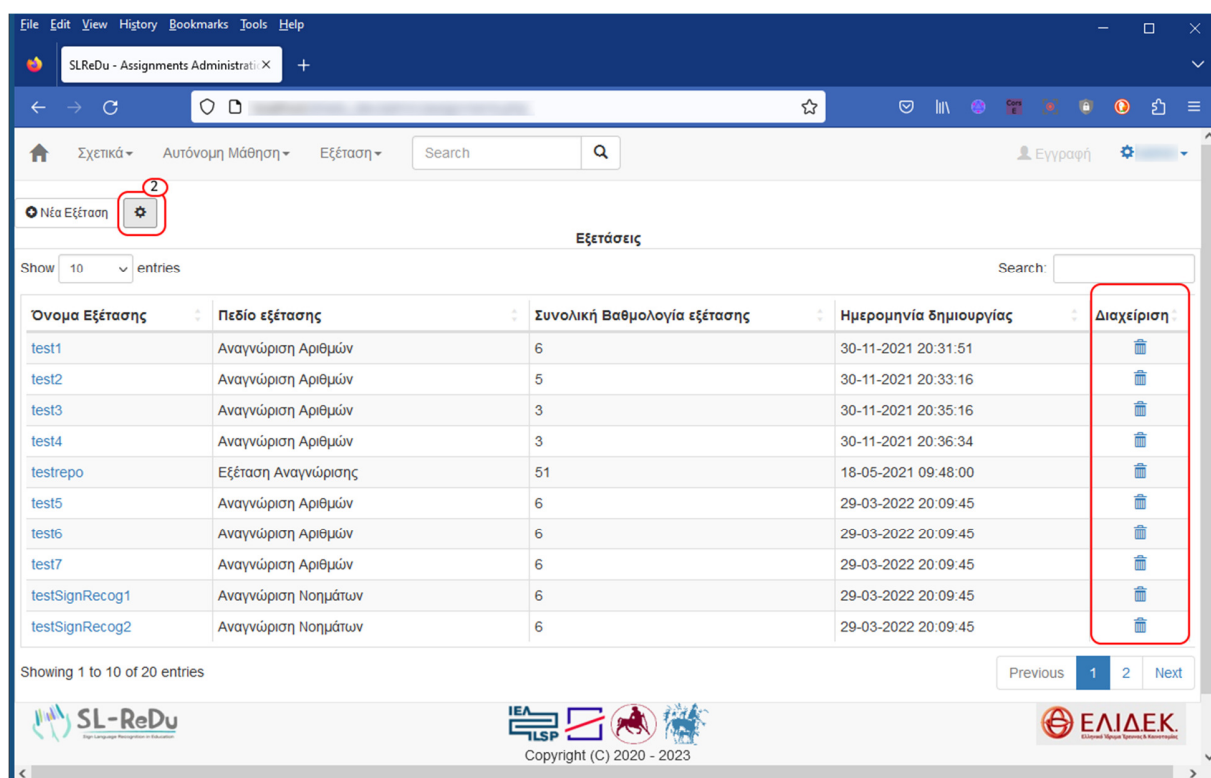


Figure 16: Managing the list of already created tests.

3 Conclusions

In this deliverable (D4.2), we presented the second version of the SL-ReDu HCI, as designed and implemented in the upcoming second version of the SL-ReDu system (Deliverable D5.5). D4.2 constitutes an enhanced version of D4.1 as mentioned in the executive summary, including a number of innovations detailed in Section 2 of this document, and it constitutes part of the third (final) project milestone (MS3).

References

- [1] B. Berrett, “Using computer-assisted language learning in an American Sign Language course,” *Innovation in Language Learning and Teaching*, vol. 6, no. 1, pp. 29–43, 2012.
- [2] S.-E. Fotinea, E. Efthimiou, and A.-L. Dimou, “Sign language computer-aided education: Exploiting GSL resources and technologies for web deaf communication.” In K. Miesenberger, A. Karshmer, P. Penaz, and W. Zagler (eds.), *Computers Helping People with Special Needs – ICCHP*, Part II, vol. LNCS-7383, pp. 237–244, 2012.
- [3] T. Haug, “Web-based sign language assessment: Challenges and innovations”, in *Proc. ALTE International Conference: Learning and Assessment - Making the Connection*, 2017.
- [4] R. Campbell, P. Martin, and T. White, “Forced choice recognition of sign in novice learners of British Sign Language,” *Applied Linguistics*, vol. 13, no. 2, pp. 185–201, 1992.
- [5] D. Chen Pichler and H. Koulidobrova, “Acquisition of sign language as a second language,” In M. Marschark and P.E. Spencer (eds.), *The Oxford Handbook of Deaf Studies in Language*. Oxford University Press, ch. 14, pp. 218–229, 2015.
- [6] E. Efthimiou, S.-E. Fotinea, A.-L. Dimou, T. Goulas, P. Karioris, K. Vasilaki, A. Vacalopoulou, M. Pissaris, and D. Korakakis, “From a sign lexical database to an SL golden corpus – the POLYTROPON SL resource”, in *Proc. Workshop on the Representation and Processing of Sign Languages: Corpus Mining (Satellite to the International Conference on Language Resources and Evaluation – LREC)*, pp. 63–68, 2016.
- [7] M. Kemp, “Why is learning American Sign language a challenge?,” *American Annals of the Deaf*, vol. 143, pp. 255–259, 1998.
- [8] G. Sapountzaki, E. Efthimiou, and S.-E. Fotinea, “D3.2: Evaluation language material organization,” *Tech. Report, SL-ReDu Project Deliverable*, Volos, Greece, 2021.
- [9] S.-E. Fotinea, E. Efthimiou, T. Goulas, C. Flouda, G. Ametoglou, G. Sapountzaki, K. Papadimitriou, and G. Potamianos, “D4.1: First version of human-computer interface,” *Tech. Report, SL-ReDu Project Deliverable*, Volos, Greece, 2021.
- [10] K. Papadimitriou, G. Potamianos, E. Efthimiou, S.-E. Fotinea, T. Goulas, and P. Maragos, “D5.3: First version of system implementation,” *Tech. Report, SL-ReDu Project Deliverable*, Volos, Greece, 2021.
- [11] G. Potamianos, K. Papadimitriou, E. Efthimiou, S.-E. Fotinea, T. Goulas, C. Flouda, and G. Ametoglou, “D5.2: Technical specifications and system architecture definition,” *Tech. Report, SL-ReDu Project Deliverable*, Volos, Greece, 2021.
- [12] *Common European Framework of References for Languages. Learning, Teaching, Assessment – Companion Volume*, Language Policy Programme, Education Policy Division, Education Department, Council of Europe, 2020 [Online]: <https://www.coe.int/en/web/common-european-framework-reference-languages> [Last Accessed: February 2023].
- [13] E. Efthimiou, S.-E. Fotinea, C. Flouda, T. Goulas, G. Ametoglou, G. Sapountzaki, K. Papadimitriou, and G. Potamianos, “The SL-ReDu environment for self-monitoring and objective learner assessment in Greek Sign Language,” *Proc. Universal Access in Human-Computer Interaction (UAHCI). Access to Media, Learning and Assistive Environments (HCII)*, pp. 72–81, 2021
- [14] G. Sapountzaki, G. Potamianos, K. Papadimitriou, E. Efthimiou, “D5.4: Evaluation of first system version” *Tech. Report, SL-ReDu Project Deliverable*, Volos, Greece, 2022.