

REMOTE LEARNING AND ASSESSMENT OF GREEK SIGN LANGUAGE IN THE UNDERGRADUATE CURRICULUM IN COVID TIME

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Abstract

Greek Sign Language (GSL) is a heavily inflected three-dimensional language with a short history of linguistic research. It has been traditionally used by the Deaf community in Greece as a first or preferred language (L1). However, a series of policy changes towards using GSL through interpreters in all settings of everyday life, educational policies demanding proficiency on GSL for all school staff where deaf students attend (law 2817/2000), has increased the need for GSL learning as a second language (L2) dramatically. Until recently, GSL was mainly taught following a non-standardized, linguistic immersion approach, in small groups and in-person settings, where subjective criteria were followed in teaching and evaluation [1].

Recent abrupt changes in health-related circumstances during the Covid-19 crisis, such as the need for interactive content in the online teaching of GSL at the tertiary education level, the inadequate network speed or students' personal computers, limitations upon numbers of participants in each online group, and use of facial masks in the classroom, has had an unprecedented impact on the methodology of teaching GSL as an L2. These were reinforced by the suggestion for uniformity of L2 content for EU members, through the Common European Framework (CEFR) [2]. While there is a significant size in GSL corpora at a lexical level as well as an abundant pool of annotated signed texts [3], the gap between a lemma and a text still remains. Word limits, heavy inflexions, as well as 3D features in phrase formation rules in GSL are different from those in Modern Greek and challenge traditional teaching methodologies, especially in an online platform. The educational platform for Sign Language Recognition in Education (SL-ReDu) has combined L2 learning methods and findings of ongoing research in sign linguistics with technological tools beyond the current state-of-the-art [4].

The paper describes the process, outcomes and challenges of updating the SL-ReDu platform. The most recent content updates cover the gap in comprehension and communication with a systematic presentation, self-evaluation and testing of short signed phrases at beginner levels (A0-A1). The layout is structured on the basis of CEFR thematic guidelines, combined with units on grammar required for beginner levels. Concepts of time, question, negation, person agreement, plural, and quantifiers for nouns and verbs are provided as learning material for both passive and active language skills.

Keywords: Sign language learning, second language learning, self-assessment, online testing, sign language recognition, distance learning, sign language linguistics.

1 INTRODUCTION

Greek Sign Language (GSL) is a minority, partially documented language used in Greece primarily as a first or preferred language in the Greek Deaf community. After implementing law 2817/2000, which requires proof of mastery of GSL for all involved in Deaf-related subjects in the public domain, the population of second language (L2) GSL users as a second language (L2) by professionals in the areas of education of the Deaf, sign language interpreting and socio-political activities has increased with a faster pace than the respective infrastructures and dissemination of material or methodology for GSL teaching. Traditionally, transmission, teaching and learning of GSL used to take place in its natural environments, i.e. in Deaf Schools and Deaf social clubs some of which still run GSL classes, as well as in a small number of families in which more than one members are native GSL users. In those environments, the learning and assessment procedures would take place and still continue to do so, in a largely experiential, immersive manner [1], with no clear curriculum or guidelines to conform to despite the fact that, at an academic level there is a bulk of applicable research findings [2]. Moreover, most

linguistic interactions in GSL until the breakout of the recent Covid-19 pandemic took place through physical contact with members of the Deaf community.

From a linguistic point of view, GSL, unlike spoken languages, uses three-dimensional space and movement for production and is perceived visually [3]. Phonological combinations as well as morphosyntactic inflexions and sentence formation rules in GSL use many articulators of the signer's body at any given moment in time, such as the hands, torso, shoulders, eyebrows, cheeks and eye gaze, among others, in order to convey lexical and grammar information.

The course of GSL for true beginners is a single-term introductory module in the undergraduate curriculum in the School of Special Education (SED) at UTH. As an obligatory module, it is attended by a total SED population of approximately 150 students or more annually, coming from all parts of Greece. Unlike GSL informal courses run in small groups privately or within the Deaf community, it is understood that the ratio between tutor and students at UTH does not allow for adequate in-person linguistic interactions with each student; however, the needs to practice this critical student population still have to be fully accommodated. In terms of the requirements of the linguistic content of the course, the introductory GSL module at UTH is the first in Greece to conform with the criteria set by the Common European Framework for Reference in Languages, spoken or signed (CEFR, CEFR-L) [4], [5]. Thus, the aim of teaching and learning GSL at the University of Thessaly (UTH), physically located in the city of Volos, away from major Deaf community centers, faces serious challenges as is also attested for relevant situations in other SLs [6]. The SL-ReDu platform of self-monitoring of learning and evaluation of GSL as an L2 is the product of an in-depth, interdisciplinary project, exploiting state-of-the-art technology and methodologies [7], [8].

Upon the worldwide restrictions during the Covid-19 crisis, GSL students at UTH had to face more challenges which were posed initially by distance education and followed by mask-wearing in the classroom; live or asynchronous video transmission for distance education in GSL, even with the use of any conventional videoconference platform far from covers the needs of a GSL university course; network speed and moving image transmissions of large numbers of students were well below what a sign language course demands; sign interactions between a physical tutor and beginner GSL as L2 students resulted to more frustration than learning; autonomous learning on behalf of the students was impossible, even when using prompts typed in Greek. The use of face masks during the last phases of the pandemic deprived students of the opportunity to see facial articulators whose role is crucial in the grammar and prosody of GSL; vice versa, a tutor could not evaluate students' performance when part of their faces had to be covered, even with a special lipreading mask.

At that point in time the SL-ReDu platform, which was still under development, proved to be a solution of critical importance.

2 METHODOLOGY

The development of the SL-REdu platform has lasted for 33 months, with a second version publicly available online at the moment of writing. For the development of the platform a group of experts from the areas of sign language linguistics, tertiary education, L2 learning, deep learning innovations and computer sciences worked together. The outputs of each stage of development were tested, validated and updated in close connection with members of the Deaf community who are active in GSL as L2 teaching, as well as with L2 users enrolled in GSL courses at UTH.

Successful attendants of the introductory course meet the requirements of A0-A1 levels. CEFR-L suggests graded levels of communicative competence from A0 (true beginner) through to C2 (native speaker) in set thematic categories, to which all country members of the European Union are to comply. The descriptors for assessment at each level involve linguistic perception, production, communication and intercultural mediation on the most common everyday activities.

The platform makes minimal use of written prompts or legends in written Greek in order to retain immersion features in GSL learning. At the presentation part of any study unit, users are exposed to GSL video content by physical signers as well as avatars, accompanied by corresponding still images for language comprehension. For the self-evaluation activities as well as for the tests included, users submit responses to questions of linguistic comprehension or linguistic production with no assistance of a physical tutor or evaluator. From the end point of use, registration and navigation are designed to be as simple and straightforward as possible. Any student can get access to the SL-ReDu platform from a personal computer or after a prompt by a tutor. Registration takes place in a matter of seconds with the only prerequisites being the availability of an Internet connection, an email account and a personal

computer device with a web camera. Tutors, on the other hand, can prompt their students to take any of the existing GSL units or they can design customized activities for language production to suit the needs of specific groups of students.

3 RESULTS

3.1 SL-ReDu platform usability

The content of the platform meets the needs of self-monitoring and self-evaluation of students on the first two pillars of CEFR, i.e. GSL comprehension and GSL production, while it provides linguistic material on the third pillar (communication). The level of difficulty in the content uploaded in the SL-ReDu platform now expands beyond the initial minimum requirements for A0-A1 levels that are covered across the thirteen weeks of a university term. More specifically, it has been used as an actual course tool for autonomous learning and self-monitoring by a total of more than 180 users in real learning circumstances, with generously positive comments on its effectiveness, and is currently being tested with groups of students of the subsequent university term (A1-A2 levels) with positive learning outcomes.

3.2 Content structure

The content in the SL-ReDu platform includes thematic vocabulary, short phrases, fingerspelling as well as common grammar items and examples in GSL. As a three-dimensional language with a wide spectrum of possible inflexions upon a base word in sign languages (SLs), the boundaries between a word and a phrase or even a full sentence are blurry for Indo-European language users. That is, at a phrasal level, morphology and syntax tend to fuse into each other through superimposed inflexions via movement and use of space, making GSL for hearing students a challenging language to acquire as a second language (L2) [9]. Moreover, writing a three-dimensional, highly grassroots, signed language (SL) is not compatible with our usual pen-and-paper approaches; on the contrary, it has to make use of moving images of high transmission speed and resolution. Video transmission of a human signer, although the most widespread means of distance communication in GSL, is not an equivalent of the written form of a sign language but similar to a recording of an oral text; using advanced avatar technology in structured texts and without involving the signer's identity is the optimal scenario for SL transcription and transmission.

In this socio-political and linguistic landscape, learning and assessment of GSL are required for L2 users who will serve in Deaf-related areas in the public domain in Greece. Although teaching and assessment of GSL as an L2, in general, do not yet follow clearly stated criteria, GSL in UTH is an academic subject taught across four semesters. Teaching, learning and assessment are systematic, structured and objective, exploiting GSL corpora and methodologies at all linguistic levels.

3.2.1 Content presentation aspects

Each learning unit consists of two distinct parts, i.e. a) new content presentation and b) self-evaluation consolidation activities. Clusters of platform content categories form separate revision activities and are further examined as c) tests.

The content of smaller and more coherent areas such as colours, for example, poses no difficulties for a beginner student to memorize, comprehend and produce in a single learning session, so the presentation of this type of content is laid out in a single level. On the other hand, a few thematic or grammar areas of vocabulary and phrases consist of larger vocabulary bulk and/or of internal variation, and have proven in practice to take longer than one session for the students to acquire; such is, for example, the thematic category 'House', which contains further subcategories for 'House spaces', 'Furniture', 'Household objects', each containing enough content for one learning session. In this type of case, the structure of the platform follows the learning pace of a beginner or nearly-beginner student and breaks content into more manageable levels.

All presentation sets can be repeated as many times as necessary, in any order the students or tutors feel that meets their needs.

3.2.2 Vocabulary size

Vocabulary categories include linguistic items unique to SLs, such as fingerspelling and classifiers besides the default thematic categories of communication [10]. These categories are structured across

2,745 screens of the platform as vocabulary items, exercises and tests. Related phrasal content in the platform further expands the total size of available content.

3.2.3 Phrases

Each vocabulary category described in the previous section is accompanied by a respective set of phrase content, focusing either on lexical or grammar phenomena. Whereas phrases under the scope of CEFR aim for communication in the target language with no reference to rules for phrasal or sentence structures, the main grammar phenomena for phrase formation in GSL are presented and assessed in a straightforward albeit explicit manner, as an acknowledgement of grammar rules is a necessary tool for the students to acquire the mechanisms for multiplying linguistic output across all of the content of the platform. In addition to the grammar categories described in Table 2, above, more grammar content such as person agreement, pronouns, quantifiers for nouns and verbs, and plural formation, is covertly presented in a less direct manner within sets of thematic or communication-oriented phrases.

Table 1. Thematic categories of vocabulary and phrases for A0-A1 content in the SL-ReDu platform.

Categories	Sub-categories						
Numbers	Numbers 0-9	Tens	11-19	Hundreds	Thousands		Revision
Finger-spelling	Letters Α, Σ, Ε, Ο	Letters Γ, Δ, Φ, Ι	Letters Ζ, Η, Π	Letters Λ, Μ, Ν, Τ	Letters Β, Κ, Ρ, Υ, Ω	Letters Θ, Ξ, Ψ, Χ	Revision
Socializing	Everyday communication	Most common verbs	Describing appearances				
Colours	-						
Family	-						
Food	Main meals	Drinks & beverages	Cooking	General food-related			
House	House spaces	Furniture	Household items	General house-related			
Clothes	-						
Shopping	Shops	Money exchanges	General shopping				
Our world	Nature	Neighbourhood	Weather	Animals	General world		
Travel	Travel	Transport					
School	-						
Work	Work related buildings	General work-related					
Revision 1	Colours, Family, Food						
Revision 2	House, Clothes, Shopping						
Revision 3	Our world, Travel						
Revision 4	School, Work						

Table 2. Grammar categories presented for A0-A1 content in the SL-ReDu platform.

<i>Grammar categories</i>	<i>Second level grammar categories</i>	<i>Third level categories</i>
Time	Lexical items	Grammar items
Functional Markers		
Question	Open questions	Closed questions
Negation		
Classifiers	Human entity	Standing, bending, laying, standing (plural)
	No dimension (point)	
	Single dimension (line)	Vertical lines, horizontal lines, vertical plurals, horizontal plurals
	Two dimensions (surface)	Non-bounded surface, bounded horizontal surface, bounded vertical surface
	Three dimensional objects	Non bounded volumes, bounded volumes, double-handed
	Outlines	Default outlines, circular outlines, small circular surfaces

3.3 Autonomous learning activities

A set of autonomous learning activities follows the presentation of each category. In the case of first-time users, it is advised to take each activity after the presentation of new content, following through the default order of the platform. However, any student can revise any category at their pace, order and time of preference, as there is no order restriction set by the platform. Besides the flexibility provided as to the order of constituents, revision activities test for comprehension of a cluster of three or four categories at a time, following mid-term consolidation benchmarks of the introductory course.

3.3.1 Linguistic comprehension activities

Autonomous learning activities are either passive, i.e. language comprehension-oriented, or active, i.e. production-oriented. Sets of activities at the vocabulary level are mixed, containing both production and comprehension questions, while phrase-level activities are divided into separate sets of passive or active. Figures 1 and 2, below, illustrate different examples of comprehension activities. In these examples, the thematic category of each activity appears on top of the video or image prompt on the screen; arrows to the right and/or left allow the student to navigate to the next or previous item, while on the right-bottom side of the prompt students can see their progress along the activity. The student can choose the correct response from a total of three available options for each item - activity response types vary among video, image, number, fingerspelled letter or sequence.

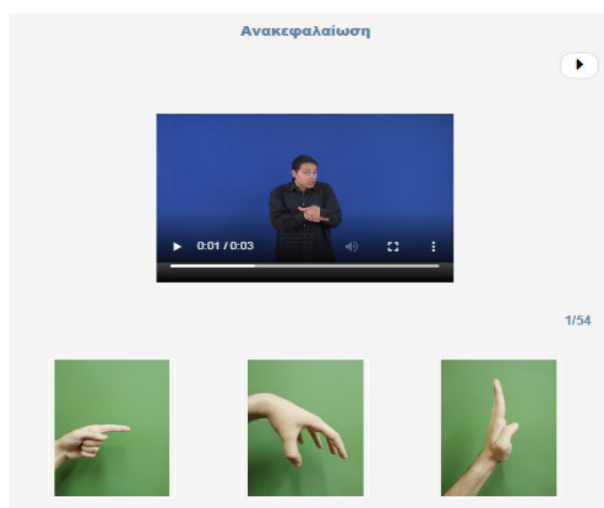


Figure 1. Classifier comprehension activity with a video prompt

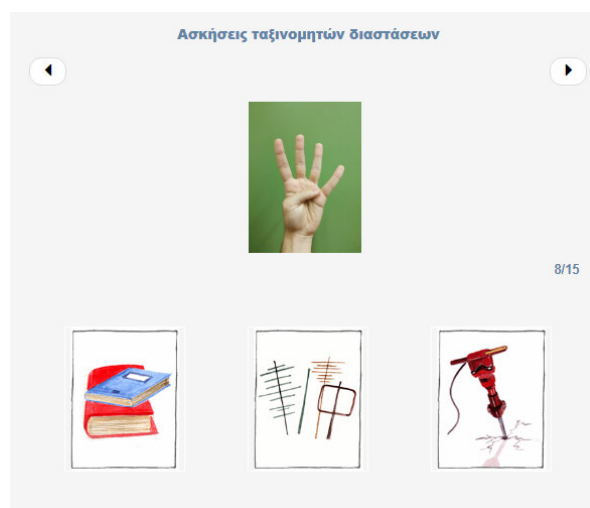


Figure 2. Classifier comprehension activity with options for different geometrical properties of objects

3.3.2 Linguistic production activities

A significant innovation in the SL-ReDu platform is the application and adaptation of state-of-the-art technology of motion and SL recognition for linguistic production activities [8]: users can self-monitor their GSL productions in real time, signing their responses in front of their web camera without use of any sophisticated equipment. Responses are recorded and instantly uploaded to the SL-ReDu server, where they are automatically recognized by a machine and evaluated as correct or incorrect, providing appropriate feedback to the students. Technical details such as the background color and complexity of the videos uploaded, or students' clothing color(s) do not hinder the automatic recognition and grading of their responses. Moreover, if the video uploaded is not technically appropriate for recognition, i.e. if students are not positioned correctly in front of their camera or if the video is too dark, students do receive a popup message on their screen asking them to adjust these parameters and resubmit their response.

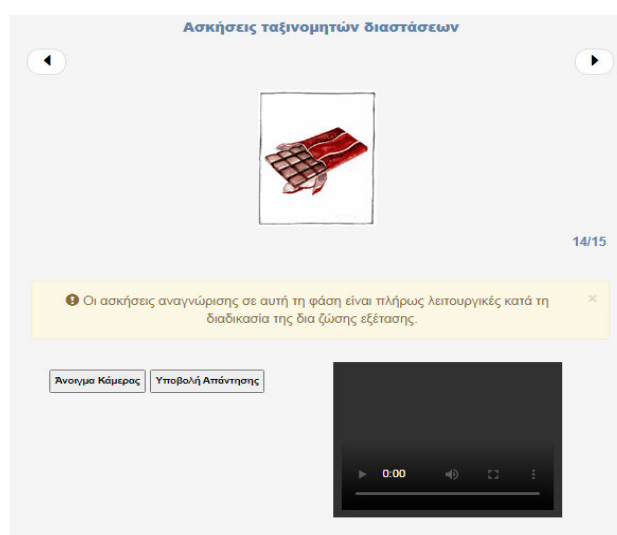


Figure 3. Linguistic production activity at vocabulary level, using an image prompt

All autonomous learning activities are timed as an indication, for the student to have a clear idea of their competence level and prepare for an upcoming test. However, during self-monitoring activities even when time is up, a student can continue to fill in their responses and can repeat the activity as many times as the student wishes. On the contrary, time limits and navigation restrictions are imposed in all tests (see below).

3.3.3 Tests

The layout and design methodology of the tests is similar to this of the self-monitoring activities (Figure 4). An essential difference is the time bars that appear at the bottom of each screen. Timing is partially controlled by the students, as they can choose between the 'slow' and 'fast' options, depending on their level of exposure to GSL.

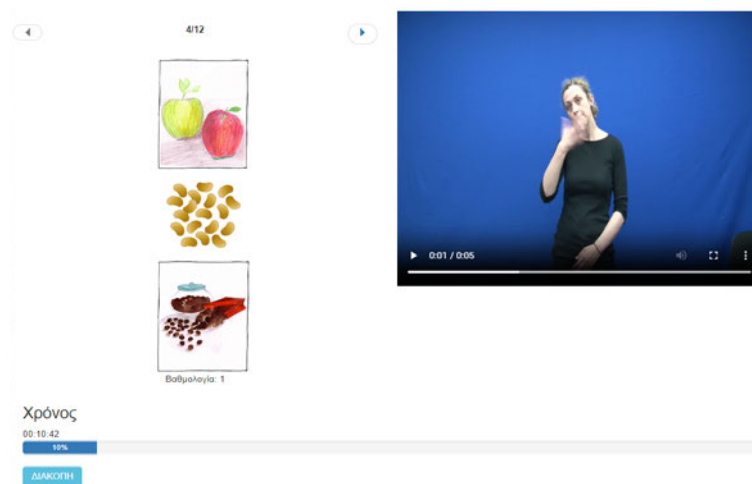


Figure 4. Test activity at phrase level, using a video prompt

In order to facilitate staff taking part in the teaching process, the newest version of the platform allows registered tutors to create language production tests with the content that suits their learners' needs.

3.3.4 Linguistic interaction and intercultural mediation

Linguistic interaction and intercultural communication are the third and fourth pillars of competence in CEFR and refer mainly to exposure of users to physical signing environments between native and non-native signers. The SL-ReDu platform prepares students for intercultural interactions through presenting and testing the constituents for communication in a vocabulary or phrasal level, as well as the rules for creating linguistic content of communication.

4 CONCLUSIONS

Overall, the use of the SL-ReDu platform allows learning processes to run smoothly and effectively in difficult-to-manage circumstances. The number of students per class did not have to be a matter of concern; self-monitoring became seamless, objective and comprehensive, covering content well beyond the introductory course and evaluation through the use of the platform was fast as well as objective and accurate. The design of the platform and the methodologies used conform with linguistic prerequisites for SL teaching and assessment as an L2, thus upgrading the status of GSL.

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REFERENCES

- [1] A.I. Hilger, T.M. Loucks, D. Quinto-Pozos, & M.W. Dye, "Second language acquisition across modalities: Production variability in adult L2 learners of American Sign Language," *Second Language Research*, vol. 31, no. 3, pp. 375-388, 2015.
- [2] E. Efthimiou & S.E. Fotinea, "GSLC: Creation and annotation of a Greek sign language corpus for HCI," in *Universal Access in Human Computer Interaction, Coping with Diversity* (C. Stephanidis, Ed), pp. 657–666, Springer Berlin / Heidelberg, 2007.

- [3] E. Efthimiou, S.E. Fotinea, A.L. Dimou, T. Goulas, P. Karioris, K. Vasilaki, A. Vacalopoulou, M. Pissaris, & D. Korakakis., "From a sign lexical database to an SL golden corpus – the POLYTROPON SL resource" in Proceedings Workshop on the Representation and Processing of Sign Language: Corpus Mining (Satellite to LREC), pp. 63–68, 2016.
- [4] <https://ec.europa.eu/social/main.jsp?catId=1202>
- [5] Counc. of Europe, 2018 & Leeson, L., Haug, T., Rathmann, C. & van der Bogaerde, B. (2018). Survey Report from the ECML Project ProSign: Sign Languages for Professional Purposes. The Implementation of CEFR for SLs in Higher Education: Results of an Intl Survey. Council of Europe, 2018
- [6] M. Kemp, "Why is learning American Sign language a challenge?," American Annals of the Deaf, vol. 143, no.3, pp. 255–259, 1998.
- [7] G. Sapountzaki, E. Efthimiou, S.-E. Fotinea, K. Papadimitriou & G. Potamianos, "Educational material organization in a platform for Greek Sign Language self-monitoring and assessment," Proc. EDULEARN, 2021.
- [8] K. Papadimitriou, G. Potamianos, G. Sapountzaki, T. Goulas, E. Efthimiou, S.-E. Fotinea & P. Maragos, "Greek Sign Language recognition for the SL-ReDu learning platform," Proc. LREC-SLTAT Works., 2022.
- [9] D. Chen Pichler, & H. Koulidobrova, "Acquisition of sign language as a second language" in The Oxford handbook of deaf studies in language (M. Marschark & P.E. Spencer, Eds.), pp.218–229, New York, NY: Oxford University Press, 2015.
- [10] G. Sapountzaki, E. Efthimiou, S.-E. Fotinea, K. Papadimitriou, and G. Potamianos, "3D Greek Sign Language classifiers as a learning object in the SL-ReDu online education platform," Proc. EDULEARN, 2022.