

Croatian Web Dictionary – Mrežnik – Linking with Other Language Resources

Lana Hudeček, Milica Mihaljević

Institute of Croatian Language and Linguistics
Republike Austrije 16, 10000 Zagreb
E-mail: lhudecek@ihjj.hr, mmihalj@ihjj.hr

Abstract

The *Croatian Web Dictionary – Mrežnik* will be a free, monolingual, hypertext online dictionary consisting of three modules (general module for adult native speakers and older schoolchildren, the module for schoolchildren aged 6 to 10, and the module for non-native speakers of Croatian). *Mrežnik* is a corpus-based dictionary, not a corpus-driven dictionary, i.e. the corpus and all data extracted from it serve only as guidelines. The project started on the 1st of March 2017 and the duration of the project is four years. *Mrežnik* is based on these two Croatian corpora: *Croatian Web Repository* (<http://rznica.ihjj.hr/index.hr.html>) and hrWaC – the *Croatian Web Corpus* (<http://nlp.ffzg.hr/resources/corpora/hrwac/>). The paper will focus on the possibilities of linking the *Croatian Web Dictionary – Mrežnik* with other language resources of the Institute of Croatian Language and Linguistics and examples of entries connected to these resources will be shown.

Keywords: Mrežnik; e-lexicography; dictionary links; hyperlinks; Croatian

1. Introduction

Digital or electronic lexicography has gained in importance in the last few years. This can be seen in the increasing number of online dictionaries and publications focusing on the field (Möhrs & Töpel, 2011: 199). In the Institute of Croatian Language and Linguistics, the *Croatian Web Dictionary – Mrežnik* is being compiled within the research project IP-2016-06-2141 financed by the Croatian Science Foundation. It is a four-year project and the work started on 1st March 2017. The project will end on 28th February 2021 and the result of the project will be the first Croatian monolingual web-born dictionary.¹ However, the end of the project will not be the end of the compilation of *Mrežnik*. *Mrežnik*² is compiled in TLex, in which the fields have been adapted to the needs of the project. Data extraction from the corpora is performed with the Sketch Engine web tool. The compilation of the dictionary is based on word sketches and a grammar sketch specially developed for the project which allows the display of the lexeme context through WordSketches. The most common collocations are sorted into syntactic categories which enable the discovery of good examples of word usage and collocations. After lexicographic processing is completed, the data will be exported

¹ On the state-of-the-art on Croatian monolingual lexicography see Despot Štrkalj et al., 2019 and on challenges of Croatian e-lexicography see Hudeček, 2018.

² For more about *Mrežnik* see in Hudeček & Mihaljević (2017a, 2017c, 2017d) and Hudeček & Mihaljević (2018a, 2018b).

from TLex to both the web application and the CLARIN European science infrastructure repository (clarin.si repository and the github.com, a software development version control system). *Mrežnik* consists of three modules: the general module (the module for adult and older schoolchildren native speakers of Croatian), the module for younger schoolchildren³, and the module for non-native speakers of Croatian.⁴ The dictionary is corpus-based and the compilers of the dictionary work with these corpora: *Croatian Web Corpus hrWaC* and *Croatian Language Repository*. The lexicographers select data from the corpora as well as from other Croatian dictionaries, websites, and resources. The main aim of the project is to compile a free, monolingual, hypertext, searchable, online dictionary of Standard Croatian with ten thousand dictionary entries in the general module, three thousand words in the module for children, and a thousand words in the module for non-native speakers of Croatian. From the beginning of the project, the plan was that dictionary entries contain links to repositories which will be created as a part of this project, and compiled in parallel with the dictionary as well as with repositories which have already been compiled within other projects conducted at the Institute of Croatian Language and Linguistics.

2. Goals of the *Mrežnik* project

The *Mrežnik* project defines five goals and objectives (Hudeček & Mihaljević, 2018b) two of which are connected to the topic of this paper:

1. Connecting the dictionary with the databases created in parallel with dictionary processing: linguistic advice database (300 pieces of advice for schoolchildren), conjunction database with description of conjunction groups and their modifiers (for all conjunctions in the dictionary), a database of idioms (50 idioms), a database of ethnics and ktetics (300 ethnics and ktetics)⁵, etc.
2. Connecting the basic dictionary with other web sources currently being created at the Institute of Croatian Language and Linguistics – *Valence Database* (<http://ihjj.hr/projekt/baza-hrvatskih-glagolskih-valencija>), *the Database of Collocations* (<http://ihjj.hr/kolokacije/>), *Repository of Metaphors* (<http://ihjj.hr/metafore/>), *Terminology Database Struna* (<http://struna.ihjj.hr/>), *Language Advice*⁶ (<http://jezicni-savjetnik.hr>), and *Better in Croatian* (<http://bolje.hr/>).

³ For more about the module for schoolchildren and non-native speakers see in Mihaljević (2018) and more about the module for non-native speakers of Croatian in Hudeček et al. (2017).

⁴ For more about the structure of the three modules see in Hudeček & Mihaljević (2017a, 2017c, 2017d).

⁵ In Croatian onomastic terminology the term *ethnic* denotes the name of the inhabitants (male and female) of cities, villages, provinces, and countries while a *ktetic* is an adjective derived from the names of cities, villages, provinces and countries.

⁶ The data on this site is, with some additions, from the book by Blagus Bartolec et al. (2015).

Mrežnik is now in its third year. However, after two years of the project these goals were expanded to include some other sources and somewhat modified, as will be shown in the text below.

3. Links in the structure of *Mrežnik*

From the beginning of the compilation of *Mrežnik* links have been considered an important component. In deciding what to link and in which way (data incorporated into the entry, internal or external links) we have taken into consideration the following:

1. "Language is a common good and a common property. Access to information about language should be fast, easy, and intuitive. The electronic dictionary should therefore be a knowledge base with language as its access point, and with simple, yet rich access to (combinations of) linguistic and non-linguistic facts." (...) "At the same time, lexicography must be able to prove itself trustworthy by offering access to sources both for usage and for normative decisions." (Gronvik & Smith Ore, 2013: 243).
2. The possibility of linking data is one of the differences between printed dictionaries and e-dictionaries. Lew (2013: 20), quoting Nesi (1999) and explaining each of the skills that Nesi analyses, says about skill 16 (Understanding the cross-referencing system in print dictionaries, and hyperlinking in electronic dictionaries): "Dictionary users' ability to take advantage of hypertext features of dictionaries is likely to improve with the growing role of the Web in today's life and work. The skill implies awareness of which elements are linked, and what the hyperlinks point to. Principles of user-centered design should ensure that hyperlinks are made evident to the users, but the actual decision of whether to follow a hyperlink needs to be grounded in an awareness of dictionary content and structure."
3. The quality of the dictionary cannot be judged by the number of links. While analysing which elements can contribute to the positive opinion of the users on the dictionary among the elements causing the dictionary to be positively judged Carolina Flinz (2011: 84)⁷ states: "limited use of links, as too many can cause readers to feel lost."

Internal links are links which link one *Mrežnik* entry to another. These links can be divided into two groups:

1. Links linking the lemma (entry word, headword) to another lemma.
2. Links linking the sense of one entry to the sense of another entry.

The difference between these two groups of internal links depends on whether the link refers to a particular meaning or to the whole entry. The links that are placed under sense are links to synonyms, antonyms, hyponyms, co-hyponyms, meronimes, and

⁷ She also stresses careful use of LSP words, which would not be understandable to the average reader. That is the reason why most of the terminology from the *Struna* database is only on hyperlinks and not incorporated into the structure of the *Mrežnik* entry.

masculine/feminine pairs⁸, as is shown on the example of the entry *veslač* (rower, a person who rows) in Table 1. The sense of the entry *veslač* is linked to the sense of the entry *veslačica* (meaning a woman who rows, a female rower). These two entries have similar definitions which differ only in the element *person regardless of gender or male vs female*, as shown in Table 2.

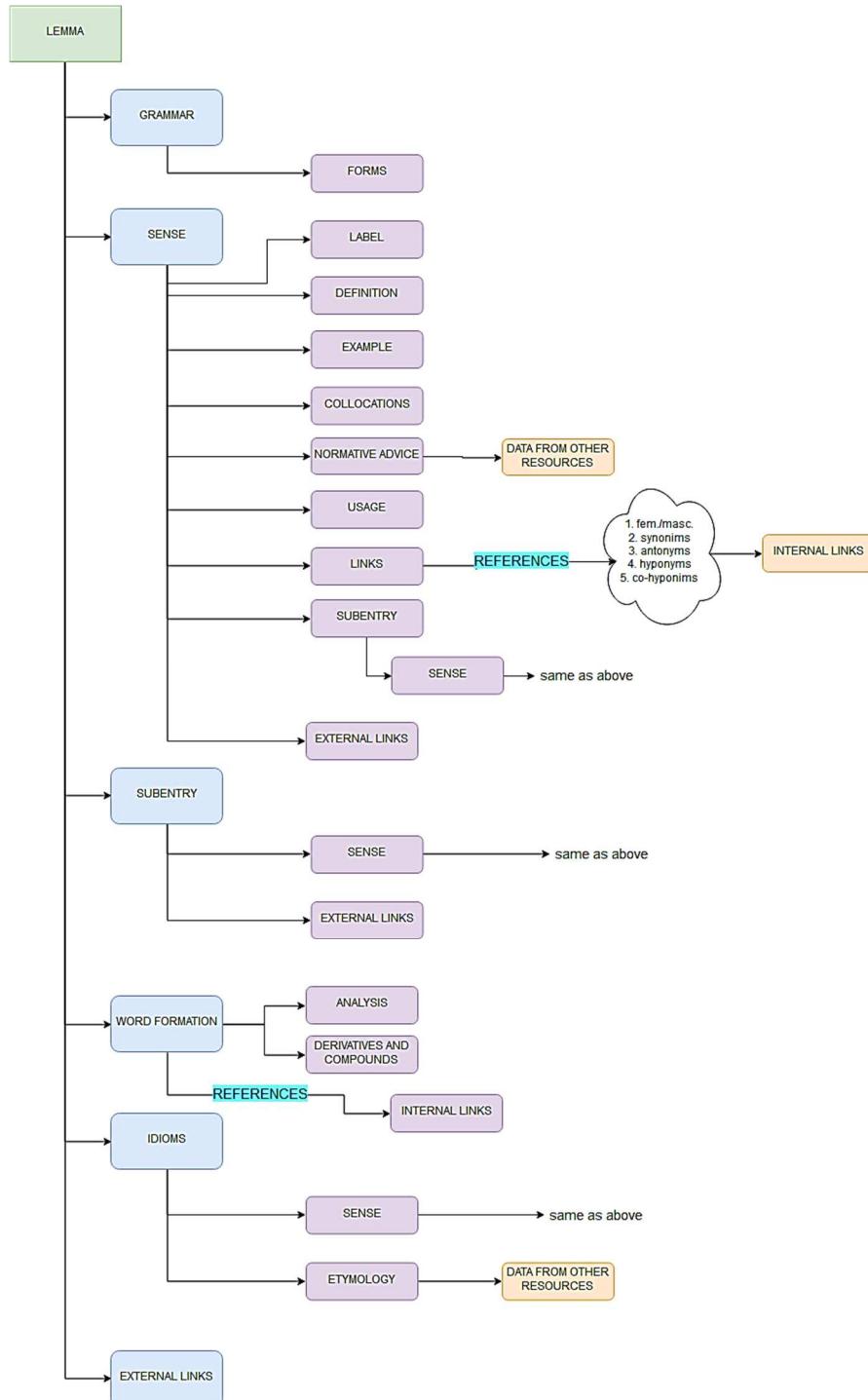


Figure 1. The structure of *Mrežnik* with the position of internal and external links.

⁸ These pairs can (as is the case with *veslač/veslačica*), but do not have to be (as is the case of *medicinska sestra / medicinski tehničar*), linked by word formation.

The structure of *Mrežnik* is shown in Figure 1. in which the position of internal and external links and data integrated from other resources is marked.

Structure elements are illustrated by the entry *veslač* (rower) in Table 1.

	Entry structure
vèslāč veslač im. m. (GA vesláča, DL vesláču, V vèsláču, I vesláčem; mn. NV vesláči, G vesláčā, DLI vesláčima, A vesláče)	grammatical block
Veslač je osoba bez obzira na spol ili muška osoba koja vesla ili se bavi veslanjem.	definition
<ul style="list-style-type: none"> – Najviše su uspjeha imali veslači mladosti, koji su pobijedili u obje utrke. – Prijelaz Britanaca u četverac mogao bi olakšati posao našim najboljim veslačima, braći Skelin, u borbi za olimpijsko odličje. 	examples
Kakav je veslač? brončani, iskusan, juniorski, kvalitetan, mlad, odličan, ponajbolji, regatni, seniorski, uspješan, srebrni Čiji je veslač? britanski, gusarov, hrvatski Što veslač može? imati (uspjeha), nastupati, osvajati (medalju), trenirati, veslati Što se s veslačem može? čestitati mu, omogućiti mu (da treniraju, uvjete), uputiti mu (čestitke) Koordinacija: jedriličari i veslači, kajakaši i veslači, kormilar i veslači, mornari i veslači, olimpijac i veslač, posada i veslači, trener i veslači, vaterpolisti i veslači, odnosi se samo na muškarce: veslačice i veslači	collocations
žensko: veslačica :1	feminine form
tvorenice: veslačev, veslačica, veslački	
tvorba: vesl-ač	word formation

Table 1: The entry *veslač* (rower) in *Mrežnik*⁹.

The links under the lemma are the links to derivatives and compounds. The word *veslač* is formed by derivation adding the suffix *-ač* to the stem *vesl-*. From the noun *veslač* the derivatives *veslačev* (rower's, belonging to the rower), *veslačica* (female rower), and

⁹ Sense includes definition, examples, collocations, normative notes, pragmatic notes and some links.

veslački (relating to rowers) are derived. Thus, the entry *veslač* is linked to entries *veslačev*, *veslačica*, and *veslački*. This information is not connected to a particular sense of the word. The internal link under sense is the link to the feminine form *veslačica*. Internal links support the systematic nature of definitions in *Mrežnik*, as is shown in Table 2 by comparing the definitions of the entry words *veslač* and *veslačica*.

Definition in <i>Mrežnik</i>	Translation and explanation
Veslač je osoba bez obzira na spol ili muška osoba koja vesla ili se bavi veslanjem.	The rower is a person regardless of the gender or a male person (man or boy) who rows (at this moment) or practices rowing (not necessarily at this moment but is active in rowing).
Veslačica je žena koja vesla ili se bavi veslanjem.	A rower (female) is a female person (woman or girl) who rows (at this moment) or practices rowing (not necessarily at this moment but is active in rowing).

Table 2: Definitions of *veslač* (rower) and *veslačica* (female rower).

4. Integrating external sources into the dictionary entry

From the beginning of the project, the idea was to connect the dictionary entries to repositories and databases which have already been compiled within other projects conducted at the Institute of Croatian Language and Linguistics. These projects are the *Valence Database* (<http://ihjj.hr/projekt/baza-hrvatskih-glagolskih-valencija>), *Repository of Metaphors* (<http://ihjj.hr/metafore/>), *Terminology Database Struna* (<http://struna.ihjj.hr/>) *Language Advice* (<http://jezicni-savjetnik.hr>), and *Better in Croatian* (<http://bolje.hr>).

The plan was also to create special databases and repositories as a part of the *Mrežnik* project. They are compiled in parallel with the *Mrežnik* dictionary. These repositories are *Language Advice for Schoolchildren* (<http://hrvatski.hr/savjeti>), *Conjunction Repository*, *Repository of Idioms* (<http://hrvatski.hr/frazemi/>), and *Repository of Ethnics and Ktetics* (<http://hrvatski.hr/etnici-i-ktetici/>).

However, during dictionary compilation, the original plan was somewhat modified. During the compilation of the dictionary, it was decided that the content of the websites *Language Advice*, *Language Advice for Schoolchildren*, *Repository of Idioms*, and *Better in Croatian* should be incorporated into the basic structure of the entry. It was decided that due to the normative nature of *Mrežnik*¹⁰ the language advice component is very

¹⁰ The normative nature of *Mrežnik* is apparent in the selection of entry words, accentuation of entry words, selection of forms in the grammatical block, selection of examples, and language advice in all three modules.

important and should not be presented only as a link. An example of normative advice is shown in Table 3.

	Entry structure
kupaònica kupaonica im. ž. (G kupaònicē, DL kupaònici, A kupaònicu, I kupaònicōm; mn. NA kupaònice, G kupaònīcā, DLI kupaònicama)	grammatical block
Kupaonica je prostorija namijenjena održavanju osobne higijene.	definition
Imenice tvorene sufiksom <i>-ona</i> od glagolskih osnova, a koje označuju prostoriju ili zgradu, npr. <i>autopraona</i> , <i>blagovaona</i> , <i>čistiona</i> , <i>gostiona</i> , <i>kupaona</i> , <i>predavaona</i> , <i>prodavaona</i> , <i>radiona</i> , <i>učiona</i> , pripadaju razgovornomu funkcionalnom stilu. U strožim stilovima hrvatskoga standardnog jezika te imenice ne treba upotrebljavati. Njemu pripadaju imenice tvorene sufiksom <i>-onica</i> : <i>autopraonica</i> , <i>blagovaonica</i> , <i>čistionica</i> , <i>gostionica</i> , <i>kupaonica</i> , <i>predavaonica</i> , <i>prodavaonica</i> , <i>radionica</i> , <i>učionica</i> .	normative advice listing words in which <i>-onica</i> should be used instead of <i>-ona</i> .

Table 3: Some elements from the entry *kupaonica* (bathroom) in *Mrežnik*.

The entry *kupaonica* (bathroom) consists of the definition (this entry has only one sense), examples, collocations (What is the bathroom like?, What can we do with the bathroom?, *Koordinacione*; In connection with the bathroom we mention:). After that, an extensive normative note follows differentiating between the usage of the noun *kupaonica* used in the standard language and the noun *kupaona* used in colloquial speech. As *Mrežnik* is a normative dictionary, dialectal forms *kupatilo*, *banja*, *badecimer* are not mentioned in the advice. The word *kupaonica* is put into a wider context of the language systems as other words with the suffix *-ona* and *-onica* are mentioned.

If we compare the normative advice from *Mrežnik* with the advice on the *Language Advice* site we see that they are the same except for the table given on the *Language Advice* site. In some other cases, there are some differences even in the basic text as it is adapted to every lemma. The advice for the word *kupaonica* from the *Language Advice* webpage is shown in Figure 2.

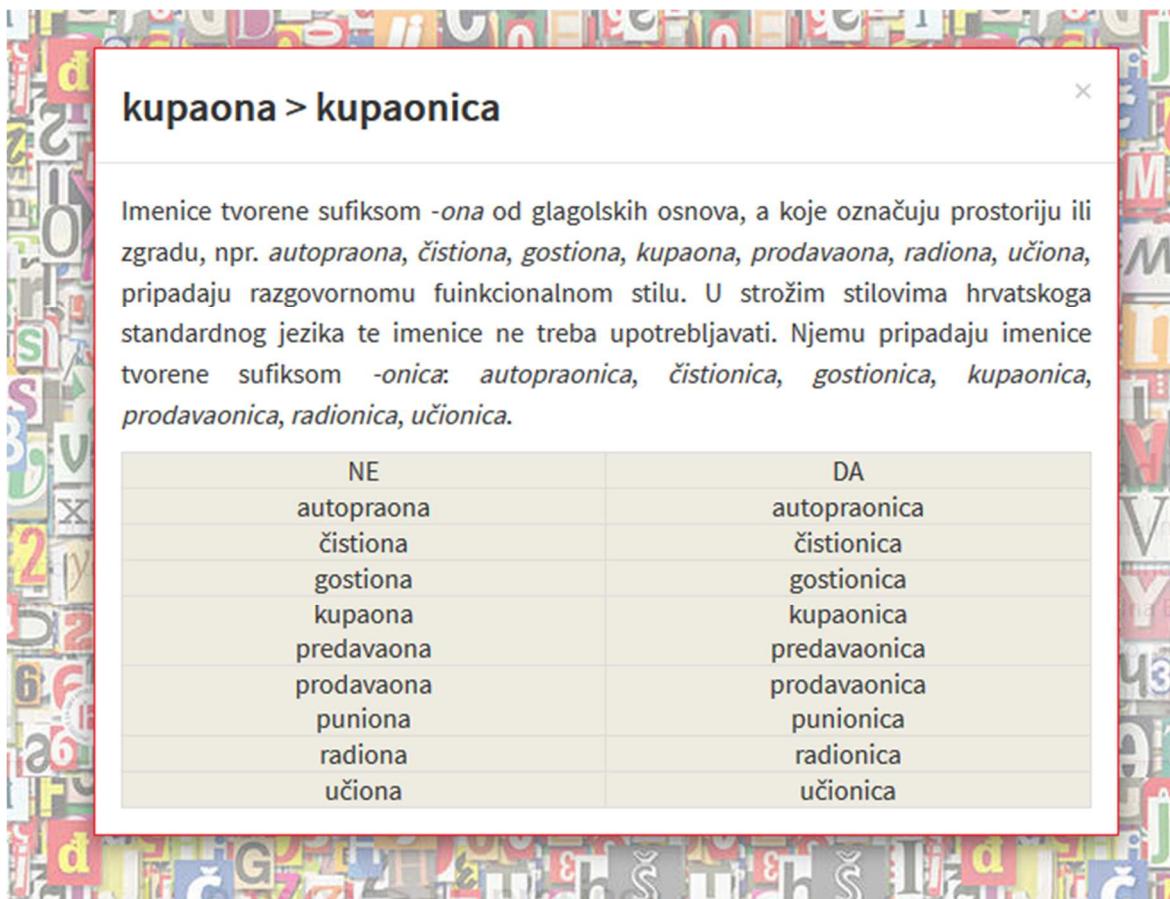


Figure 2: The advice for the word *kupaona* on the *Language Advice* site.

This piece of language advice is placed in each entry to which it applies and it is somewhat modified if needed so that it mentions the entry word (followed by some other prototype examples to which the rule applies). In *Mrežnik* this piece of advice will appear in the entries of words listed in Table 4.

Colloquial	Standard	English
autopraona	autopraonica	car wash
blagovaona	blagovaonica	dining room
čekaona	čekaonica	waiting room
češljaona	češljaonica	hairdresser's
čistiona	čistionica	drycleaner's
fotokopiraona	fotokopiraonica	photocopying shop
gostiona	gostionica	bar, inn, pub, tavern

Colloquial	Standard	English
kazniona	kaznionica	jail
kladiona	kladionica	betting house
krstiona	krstionica	baptistery
ljevaona	ljevaonica	foundry
praona	praonica	wash-house, laundry-room
predavaona	predavaonica	classroom, lecture-room
prediona	predionica	cotton-mill, spinning mill
prodavaona	prodavaonica	store
propovjedaona	propovjetaonica	pulpit
radaona	rađaonica	delivery room
radiona	radionica	workshop
skakaona	skakaonica	ski jump hill, diving board
slušaona	slušaonica	listening room
spalionna	spalionica	incineration plant
spavaona	spavaonica	dormitory
štaviona	štavionica	tannery
štlediona	štledionica	savings bank
taliona	talionica	smelting plant
učiona	učionica	classroom

Table 4: Words ending in *-ona* and *-onica*.

In each entry, the piece of advice will be modified so the entry word appears in the first place in the first and last sentences of the normative advice, as is shown in Table 5.

Croatian	English
Imenice tvorene sufiksom <i>-ona</i> od glagolskih osnova, a koje označuju prostoriju ili zgradu, npr. x ¹¹ , <i>autopraona</i> , <i>čistiona</i> , <i>gostiona</i> , <i>kupaona</i> , <i>prodavaona</i> , <i>radiona</i> , <i>učiona</i> itd. pripadaju razgovornomu stilu.	Nouns formed by the suffix <i>-ona</i> from verbal stems which denote a room or a building, e.g. x, <i>autopraona</i> , <i>čistiona</i> , <i>gostiona</i> , <i>kupaona</i> , <i>prodavaona</i> , <i>radiona</i> , <i>učiona</i> (car wash, drycleaner's, bar, bathroom, store, workshop, classroom), etc. belong to the colloquial style.
Njemu pripadaju imenice tvorene sufiksom <i>-onica</i> : x, <i>autopraonica</i> , <i>čistionica</i> , <i>gostionica</i> , <i>kupaonica</i> , <i>prodavaonica</i> , <i>radionica</i> , <i>učionica</i> .	To this style ¹² belong those words formed with the suffix <i>-onica</i> belong: x, <i>autopraonica</i> , <i>čistionica</i> , <i>gostionica</i> , <i>kupaonica</i> , <i>prodavaonica</i> , <i>radionica</i> , <i>učionica</i> (x, car wash, drycleaner's, bar, bathroom, store, workshop, and classroom).

Table 5: Normative advice for words ending in *-ona*.

In order to ensure that compilation is conducted in a systematic way we have compiled lists of words belonging to a grammatical or semantic class to which a particular piece of advice applies. Here are some entry words for which such systematic but adapted pieces of advice are given:

- ***-ist or -ista***: words ending in *-ist* and not those ending in *-ista* should be used: *aktivist* (activist), *alpinist* (alpinist), *biciklist* (cyclist), *daltonist* (colour blind person), *egoist* (egoist), *harfist* (harp player), *idealistic* (idealist), *iluzionist* (illusionist), *kroatist* (Croatian language specialist), *okulist* (ophthalmologist, eye doctor), *optimist* (optimist), *perfekcionist* (perfectionist), *pesimist* (pessimist), *pijanist* (pianist), *šahist* (chess player), *gitarist* (guitar player), *fagotist* (fagot player), *flautist* (flute player), *vaterpolist* (water polo player),
- ***-čičin or -čicin*** adjectives derived from female nouns ending in *-čica* should be those ending in *-čičin* and not in *-cičin*: *bacačičin* (belonging to a female thrower), *beračičin* (belonging to a female picker), *boksačičin* (belonging to a female boxer), *crtacičičin* (belonging to a female draughtsman), *dizačičin* (belonging to a female lifter), *djevojčičin* (belonging to a girl), *dostavljačičin* (belonging to a female deliverer), *glasacičičin* (belonging to a female voter), *glasoviračičin* (belonging to a female pianist), *gudačičin* (belonging to a female

¹¹ X denotes the entry word.

¹² Meaning the formal style of the Croatian language.

string player), *igračičin* (belonging to a female player), etc.

- **-arov or -arev:** adjectives ending in *-arov* as well as in *-arev* belong to standard Croatian, i.e. their normative status is the same: *alkoholičarev/alkoholičarov* (belonging to an alcoholic), *bankarev/bankarov* (belonging to a banker), *bibliotekarev/bibliotekarov* (belonging to a librarian), *bolničarev/bolničarov* (belonging to a male nurse), etc.
- **-ica or -inja:** advice on when to use female nouns ending in *-ica* and when to use those ending in *-inja*, *antropologica/antopologinja* (female anthropologist), *kandidatica/kandidatinja* (female candidate), *pedagogica/pedagoginja* (female pedagogue), *psihologica/psihologinja* (female psychologist), etc. is given.
- etc.

In a similar way, data from the database *Better in Croatian* is incorporated into the normative advice. This is illustrated by the entry *poveznica* (link). In the normative advice, the relation between the Croatian term *poveznica* and the English term *link*, which is also used in Croatian, especially in the colloquial style, is explained as shown in Table 6.

	Entry structure
pòveznica poveznica im. ž. (G pòveznicē, DL pòveznici, A pòveznicu, I pòveznicōm; mn. NA pòveznice, G pòveznīcā, DLI pòveznicama)	grammatical block
<i>inform.</i> Poveznica je sličica, riječ ili izraz u dokumentu na internetu koji taj dokument povezuju s kojim drugim dokumentom na internetu.	field label and definition
U engleskome se jeziku nazivom <i>link</i> označuje sličica ili riječi u dokumentu na internetu koje taj dokument povezuju s kojim drugim dokumentom. Umjesto engleske riječi <i>link</i> , koja u hrvatskome pripada samo računalnome žargonu, u standardnome jeziku treba upotrebljavati hrvatski naziv <i>poveznica</i> .	normative advice – stating the relation between Croatian <i>poveznica</i> and English <i>link</i>

Table 6: Some elements from the entry *poveznica* (link).

The piece of advice from the database *Better in Croatian* adapted to the dictionary entry appears in the normative note of these entries: *pisač* (printer), *slagalica* (puzzle), *poslužilac* (server), etc.

It has also been decided that pragmatic data (usage notes), produced as a part of the *Mrežnik* project¹³, should be incorporated into the entry due to the necessary

¹³ At this moment a separate pragmatic database doesn't exist but in the future it would be useful to create it and pragmatic notes from *Mrežnik* could be a starting point.

adjustment to each entry. Pragmatic data will be illustrated by the entry *bog* (an informal greeting coexisting with the greeting *bok*), as shown in Table 7.

	Entry structure
bôg bog <i>usk.</i>	grammatical block
<i>razg.</i> Bog je neformalni pozdrav koji se upotrebljava pri susretu i pri rastanku.	field label and definition
U hrvatskome jeziku u neformalnoj komunikaciji upotrebljavaju se pozdravi <i>bog</i> i <i>bok</i> . Pozdrav <i>bog</i> nastao je skraćivanjem pozdrava <i>pomoz' Bog, Bog s tobom</i> ili <i>daj Bog</i> . Upotrebljava se u primorskim i istočnim dijelovima Hrvatske. Podrijetlo je pozdrava <i>bok</i> nejasno jer se smatra da je ili nastao obezvučivanjem krajnjega suglasnika pozdrava <i>bog</i> ili ga se, što je manje vjerojatno, povezuje s arhaičnim austrijskim pozdravom <i>Bücken, mein Bücken</i> 'naklon, moj naklon'. Upotrebljava se u Zagrebu i sjevernoj Hrvatskoj.	pragmatic (usage) note – stating in which areas of Croatia the greeting <i>bog</i> and <i>bok</i> are used.

Table 7: Pragmatic note (usage) in the entry *bog* (greeting).

In the pragmatic note, after analysing the etymology of the greeting it is stated that the greeting *bok* is used in Zagreb and northern parts of Croatia, while the greeting *bog* is used in the coastal and eastern parts of Croatia. The same pragmatic note appears in the entry *bok*.

Data from the *Repository of Idioms* is also included into the idiom subentry as is shown in the subentry *Ahilova peta* (Achilles' heel) of the entry *peta* (heel) in Table 8.

	Entry structure
péta peta im. ž. (G pétē, D pêti, A pêtu, L pétu, I pétōm; mn. NA pête, G pétā, DLI pétama)	grammatical block
Ahilova peta	subentry
Frazem je nastao prema grčkome mitu o neustrašivome borcu Ahileju, kojega je njegova majka Tetida, u želji da ga učini neranjivim, nakon rođenja umočila u rijeku Stiks. Pritom ga je držala za petu, koja je ostala suha. Tako je peta postala jedino ranjivo mjesto na njegovu tijelu.	etymology of the idiom

Table 8: Explanation of the meaning of the idiom *Ahilova peta* (Achilles' heel) in the entry *peta*.

In the module for schoolchildren advice from the website *Croatian at School* created in parallel with the compilation of *Mrežnik* is used and adapted to each entry, e.g. in the entry *bicikl* (bicycle) the following piece of language advice is incorporated, as shown in Table 9.

Croatian	English
Riječ <i>bicikl</i> pripada hrvatskomu standardnom jeziku, a riječ <i>bicikla</i> pripada nekim hrvatskim dijalektima. Zato su u standardnome jeziku točne rečenice: <i>Vozim novi bicikl.</i> , <i>Kupio sam novi bicikl.</i> , <i>To je moj novi bicikl.</i> , a nisu točne rečenice <i>Vozim novu biciklu.</i> , <i>Kupio sam novu biciklu.</i> , <i>To je moja nova biciklu.</i>	The word <i>bicikl</i> (bicycle) belongs to standard Croatian while the word <i>bicikla</i> belongs to some Croatian dialects. Thus sentences <i>Vozim novi bicikl.</i> , <i>Kupio sam novi bicikl.</i> , <i>To je moj novi bicikl</i> belong to standard Croatian and <i>Vozim novu biciklu.</i> , <i>Kupio sam novu biciklu.</i> , <i>To je moja nova biciklu.</i> do not.

Table 9: Advice for schoolchildren incorporated into the entry *bicikl*.

Although dialectal information does not usually appear in *Mrežnik*, this piece of advice is given due to the frequency of the mistake. For example, if we search for the lemma *bicikl* in hrWaC we find 16,638 occurrences, and if we search for the lemma *bicikla* we find 18,450 occurrences. However, if we look at the concordance of *bicikla*, we see that in many sentences the word *bicikl* was actually used but it has been wrongly lemmatized¹⁴, e.g. under *bicikla* we find these randomly selected sentences which show that the form of the word *bicikl* and not *bicikla* is used:

Voditelj projekta Krešimir Herceg ispred udruge je donirao dva dječja bicikla Dječjem vrtiću Vjeverica u Starom Petrovom Selu, koji je u sklopu Dječjeg vrtića Nova Gradiška.

Za sastavljanje lanca brdskog bicikla potreban je poseban alat.

5. External links

External links are links to other language resources created within the *Mrežnik* project or created separately at the Institute of Croatian Language and Linguistics. The databases compiled in parallel with the *Mrežnik* project are linguistic advice database (300 pieces of advice for schoolchildren), a conjunction database, with descriptions of conjunction groups and their modifiers (for all conjunctions in the dictionary), a database of idioms (50 idioms), a database of ethnics and ktetics (300 ethnics and ktetics). Advice for children and the etymology of idioms is incorporated within the

¹⁴ On a sample of 100 occurrences of the lemma *bicikla* 83 were the occurrences of *bicikl* but were wrongly lemmatized under *bicikl*.

dictionary entry. The database of ethnics and ktetics is linked to the dictionary, entry as is shown in the entry for *bečki* (Viennese) in Table 10 and Figure 3.

	Entry structure
bêčkî bečki prid. G bêčkôg(a); ž. bêčkâ, s. bêčkô	grammatical block
Bečki je koji se odnosi na Beč i Bečane.	definition
Hrvatski u školi - Etnici i ktetici: http://hrvatski.hr/etnici-i-ktetici/	external link to the database of ethnics and ktetics

Table 10: Entry *bečki* (Viennese) connected to the database of ethnics and ktetics.

Beč, Bečanin, Bečanka, bečki
Bêč, G Béča, D Béču, A Bêč, L u Béču, I Béčom
Béčanin, GA Béčanina, DL Béčaninu, V Béčanine, I Béčaninom; mn. NV Béčani, G Béčanâ, DLI Béčanima, A Béčane
Béčânska, G Béčânkë, DL Béčânski, A Béčânsku, V Béčânsko, I Béčânkôm; mn. NAV Béčânske, G Béčânkâ/Béčânkî, DLI Béčânkama
bêčkî

Napomena: U nekim starijim tekstovima i pravopisima s početka XX. stoljeća zapisan je i muški etnik Bečlja. Na kajkavskome području Beč se nekoć nazivao i Dunaj.

Figure 3: Entry *Beč* (Vienna) from the database of ethnics and ktetics.

From the planned databases all are connected to some entries in *Mrežnik*. During dictionary compilation it turned out that the database that had been most often linked from *Mrežnik* was the terminological database *Struna*.¹⁵ The entry *broj* (number) in *Mrežnik* is connected to *broj* in *Struna* and the subentries of the entry *broj* in *Mrežnik* *cijeli broj* (whole number), *glavni broj* (cardinal number), *negativni broj* (negative number), *neparni broj* (odd number), etc. are connected to respective entries in *Struna* as is shown in Figure 4.

¹⁵ *Struna* is a database of Croatian Special Field Terminology. It was officially inaugurated on the web in February 2012. Its aim is to gradually make available to the public the standardized Croatian terminology for all professional domains.

broj	<i>im. m. jd.</i>
definicija	osnovni matematički pojam koji nastaje apstrahiranjem predodžbe o prebrojavanju konačnoga skupa
istovrijednice	engleski: number
podređeni nazivi	cijeli broj, kompleksni broj, prirodni broj, realni broj, slučajni broj, suprotni broj
napomena	Broj također nastaje apstrahiranjem predodžbe o duljini ili ploštinu određenih objekata.
razredba	polje: matematika grana: algebra projekt: Izgradnja hrvatskoga nazivlja u matematici – temeljni pojmovi
prirodni broj	
skraćeni oblik naziva	broj
definicija	broj koji pripada skupu $\{1, 2, 3, \dots\}$
istovrijednice	engleski: natural number
podređeni nazivi	glavni broj, prosti broj, redni broj, savršeni broj, složeni broj
simbol	\mathbb{N}
napomena	Ovdje ne navodimo i nulu kao prirodni broj iako je neki matematičari smatraju prirodnim brojem. Skup prirodnih brojeva s nulom uobičajeno se označuje s $\mathbb{N}_0 = \{0, 1, 2, 3, \dots\}$.
razredba	polje: matematika grana: algebra projekt: Izgradnja hrvatskoga nazivlja u matematici – temeljni pojmovi

Figure 4: Entry *broj* (number) in the terminological database *Struna*.

However, during the compilation of *Mrežnik*, it turned out that there are a number of other resources of the Institute of Croatian Language and Linguistics that could be connected to *Mrežnik*: *Croatian School Grammar* (<http://gramatika.hr/>), *Croatian Orthography Manual* (<http://pravopis.hr/>), language games (<http://hrvatski.hr/igre/>), and some papers from the popular journal *Hrvatski jezik* (<https://hrcak.srce.hr/hrjezik>), and this would present useful information. These resources were included only if we thought that they would be useful to potential users.

In the above-mentioned entry *broj* (number), in addition to mathematical meanings there are also grammatical meanings of the same word. These meanings are connected to the *Croatian School Grammar* (the chapter on number).

The entry *palatalization*¹⁶ is also connected to the *Croatian School Grammar*. The entry palatalization has the structure shown in Table 11.

	Entry structure
palatalizácia palatalizacija im. ž. (G palatalizácijē, DL palatalizáciji, A palatalizáciju, I palatalizácijom; mn. N palatalizácije, G palatalizácijā, DLI palatalizácijama, A palatalizácije)	grammatical block
gram. Palatalizacija je glasovna promjena u kojoj nenepčanici <i>k</i> , <i>g</i> , <i>h</i> , <i>c</i> zamjenjuju nepčanicima <i>č</i> , <i>ž</i> , <i>š</i> ispred <i>e</i> i <i>i</i> .	field label and definition
– Palatalizacija dolazi od latinske riječi <i>palatum</i> , što znači nepce. – U slav. jezicima tzv. prva palatalizacija, provedena u praslav. jeziku, izmjenila je grlene suglasnike <i>k</i> , <i>g</i> , <i>h</i> u <i>č</i> , <i>ž</i> , <i>š</i> (kod nas ispred <i>e</i> : <i>junak</i> – <i>junače</i> ; ispred <i>i</i> : <i>noga</i> – <i>nožica</i> ; ispred nepostojanog <i>a</i> nastalog od poluglasa <i>ɛ</i> : <i>prah</i> – <i>prašak</i>).	examples
Kakva je palatalizacija? prva, druga, treća	collocations
Što se s palatalizacijom može? ne provesti je, provesti je	
mrtve tvorenice: palatalizacijski	word formation
Hrvatska školska gramatika: http://gramatika.hr/pravilo/palatalizacija/8/#pravilo	external link to Croatian School Grammar

Table 11: The entry *palatalization* connected with the *Croatian School Grammar*.

This is connected to the chapter on palatalization in *Croatian School Grammar* (Hudeček & Mihaljević, 2017b):

¹⁶ Palatalization refers to the process of change in sound in which a non-palatal consonant *k*, *g*, *h*, *c* changes to a palatal consonant *č*, *ž*, *š* in front of *e* and *i*.

PALATALIZACIJA

Nenepčanici (nepalatali) *k*, *g*, *h*, *c* zamjenjuju se nepčanicima (palatalima) *č*, *ž*, *š* ispred *e* i *i*.

nepčanik	<i>k</i>	<i>g</i>	<i>h</i>	<i>c</i>
nepčanik	<i>č</i>	<i>ž</i>	<i>š</i>	<i>č</i>
primjer	<i>majka – majčin</i>	<i>Bog – Bože</i>	<i>duh – duše</i>	<i>učiteljica – učiteljičin</i>

Pri palatalizaciji suglasnici *k* i *c* uvijek daju *č*, a ne *ć*: *pekoh – peče, ujak – ujače, zec – zeče*.



Figure 5: The chapter on *palatalizatin* in the *Croatian School Grammar*.

In a similar way entries *imenica*, *glagol*, *pridjev* (*noun*, *verb*, *adjective*), etc. are connected to chapters of the *Croatian School Grammar*.

As can be seen above, the *Croatian School Grammar* has illustrations which can facilitate learning and make it more fun. To the same end, certain dictionary elements have been gamified. This is especially true for the module for non-native speakers and schoolchildren, but even some entries in the basic module have gamification elements.¹⁷ This will be illustrated by the entry *glagolica* (Glagolitic script) shown in Table 12, which is connected to the table of Glagolitic letters from the *Croatian Orthographic Manual* (Jozić et al., 2013) and contain links to games for learning the Glagolitic script.

¹⁷ For more on the gamification of language content see in Mihaljević, J., 2016a, 2016b, 2017, and Mihaljević, A. & Mihaljević, J. (2019).

	Entry structure
glagòljica glagoljica im. ž. (G glagòljicē, DL glagòljici, A glagòljicu, I glagòljicōm)	grammatical block
<i>ling.</i> Glagoljica je najstarije slavensko pismo nastalo polovicom 9. st., koje je poslije 12. stoljeća u stalnoj uporabi samo u Hrvatskoj.	field label and definition
<ul style="list-style-type: none"> – U Jurandvoru se održavaju radionice u kojima se može naučiti pisati uglatu glagoljicu. – Mogu se pohvaliti da uz čirilicu i latinicu pišem i čitam glagoljicu. – Ploča je pisana latinicom i glagoljicom te na dva jezika: latinskim i starohrvatskim. 	examples
Kakva je glagoljica? ispisana, tiskana, uklesana; kurzivna, obla, uglata Što se s glagoljicom može? pisati njome, uklesati je Koordinacija: bosančica i glagoljica, čirilica i glagoljica, latinica i glagoljica	collocations
tvorenica: glagoljični	word formation
Hrvatski u školi: http://hrvatski.hr/igra/7/ Hrvatski pravopis: http://pravopis.hr/uploads/slova-2.pdf	external links to language games and the <i>Croatian Orthography Manual</i>

Table 12: The entry *glagoljica* (Glagolitic script) from *Mrežnik*.

The entry *glagoljica* is connected to the table of Glagolitic letters from the *Croatian Orthography Manual* shown in Figure 6.

slovo	brojevna vrijednost	transliteracija	transkripcija (čitanje)
Ⰱ	1	a	a
Ⰲ	2	b	b
Ⰳ	3	v	v
Ⰴ	4	g	g
Ⰵ	5	d	d
Ⰶ	6	e	e, je
Ⰷ	7	ž	ž
Ⰸ	8	í	z
Ⰹ	9	z	z
Ⰺ, Ⰻ	10	ï	i
Ⰼ	20	i	i, ji, j
Ⰽ	30	â	j
Ⰾ	40	k	k

Figure 6: The Glagolitic script from the *Croatian Orthographic Manual*.

The entry *glagoljica* is also connected to educational games for learning the Glagolitic script. One of these games is shown in Figure 7.

Znam glagoljicu

Nauči uglatu ili oblu glagoljicu s pomoću natjecateljskoga kviza. Za svako pitanje imaš 10 sekunda za odgovor.

Римскіја црквена језуји
како да се читају и пишу-је
тако да се читају и пишу-је
многи-је. Је већа је
што је већа је
и већа је
започиње се
започиње се

započni kviz s ȝyamfisom glagoljicom

započni kviz s ȝemaozom glagoljicom

Figure 7: A quiz for learning the Glagolitic script made by Josip Mihaljević.

The entries and subentries denoting punctuation marks: *zarez*, *točka*, *točka sa zarezom*, etc. (comma, period, semicolon, etc.) are connected to chapters of the *Croatian Orthography Manual*, where rules on how to use these marks are explained. This is illustrated by the subentry *točka sa zarezom* (semicolon) of the entry *točka* (period).

	Subentry structure
točka sa zarezom	subentry
pravop. Točka sa zarezom pravopisni je znak (;) koji se piše pri jačemu odvajanju od onoga koje označuje zarez, a slabijemu od onoga koje označuje točka	definition
– Točka sa zarezom (;) razgodak je koji ima vrijednost između točke i zareza. – Točka sa zarezom na zapešću: Što označava novi trend među korisnicima Instagrama?	examples
U hrvatskome pravopisnom nazivlju u istome se značenju upotrebljavaju nazivi točka-zarez i točka sa zarezom. Budući da u nazivlju istoznačenice nisu poželjne, a polusloženice se ne uklapaju u strukturu hrvatskoga jezika te ih je, kad je to moguće, bolje zamijeniti istoznačnim nazivom drugčije strukture, prednost se daje nazivu točka sa zarezom.	normative advice
mrtvi sinonim: točka-zarez	word formation
Hrvatski pravopis: http://pravopis.hr/pravilo/tocka-sa-zarezom/62/	external link to the <i>Croatian Orthography Manual</i>

Table 13: The subentry *točka sa zarezom* (semicolon) connected with the *Croatian Orthography Manual*.

Točka sa zarezom

Točka sa zarezom piše se:

a) kao znak jačega odvajanja od onoga koje označuje zarez, a slabijega od onoga koje označuje točka: [Kad ga vidim, radujem se; ne dođe li, tugujem; teško je reći što će koji dan donijeti.](#)

b) pri nabranjanju ako je u cjelinama koje se nabrajaju već upotrijebljen zarez:

- [Veznici nezavisnosloženih rečenica dijele se na: sastavne – i, pa, te, ni, niti; suprotne – a, ali, no, nego, već; rastavni – ili...](#)
- [Tijekom dana toplomjer je pokazivao: 36,7; 37,2; 38,2.](#)

Figure 8: The chapter *Točka sa zarezom* (semicolon) from the *Croatian Orthography Manual*.

Although *Mrežnik* is linked to many language resources from the Institute of Croatian Language and Linguistics, it does not as yet contain a link to an etymological dictionary as such a Croatian dictionary does not exist online yet. Hopefully, the near future will witness a link to an etymological dictionary (the *Croatian Etymological Dictionary* is compiled at the Institute).¹⁸ However, at the moment some entries are linked to short etymological articles from the Institute's journal for the popularization of the Croatian language, *Hrvatski jezik* (*Croatian Language*), which is available online. For example, the entry *ministar* (minister) shown in Table 14 from *Mrežnik* is connected to a short text on the etymology of the words *minister* and *magister* from the etymological section (*Odakle nam riječi?* – Where do words come from?) of the journal *Hrvatski jezik* (Ivšić, 2014), as shown in Figure 9.

¹⁸ Matasović et al., 2016.

	Entry structure
mìnistar ministar im. m. (GA mìnistra, DL mìnistru, V mìnistre, I mìnistrom; mn. NV mìnistri, G mìnistàrā, DLI mìnistrima, A mìnistre)	grammatical block
Ministar je osoba ili muškarac koji je na čelu kojega ministarstva.	definition
<ul style="list-style-type: none"> – Ministar je najavio i novi sustav ocjenjivanja liječnika primarne zdravstvene zaštite na principu od jedan do pet zvjezdica. – Ministar je također naglasio da je trenutna dužnička kriza prilika za stvaranje čvršće fiskalne unije unutar eurozone. 	examples
Kakav je ministar? bivši, nekadašnji, resorni, tadašnji; britanski, francuski, njemački, slovenski; HDZ-ov Čega je tko ministar? financija, gospodarstva, obrane, policije, prometa, zdravstva, znanosti Što ministar može? istaknuti (ulogu novih naraštaja, da...), naglasiti (da..., kako ...), najaviti (nastavak suradnje, podiizanje trošarina, sustav ocjenjivanja liječnika, potpisati (memorandum, rješenje, ugovor) Što se s ministrom može? optužiti ga, obavijestiti ga, pitati ga, pozvati ga, smijeniti ga, upoznati ga, zadužiti ga Koordinacija: ministar i potpredsjednik Vlade, ministar i premijer; ministri i saborski zastupnici, odnosi se samo na muškarce: ministri i ministrike U vezi s ministrom spominje se: dužnost, izjava, ostavka, pomoćnik, sastanak, zamjenik	collocations
tvorenice: ministarski, ministarstvo, ministrica, ministrov	word formation
Hrvatski jezik: https://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=245998	external links to a paper in the journal <i>Hrvatski jezik</i>

Table 14: Some elements from the entry *ministar* (minister) in *Mrežnik*.

DUBRAVKA IVŠIĆ

Tko je veći, magistar ili ministar?

Etimološke veze hrvatskih riječi *magistar* i *ministar*

Riječ *magistar* u hrvatskome je jeziku razmjerno nova, potvrđena je od 19. stoljeća i ima dva osnovna značenja: 'akademski titula' i 'ljekarnik'. Posuđena je iz latinskoga *magister* 'učitelj, nadređeni, vođa, glava', uz posredovanje njemačkoga jezika. Latinska je riječ postala od kontrastivnoga pridjeva **magis-tero-*, koji u osnovi ima isti indoeuropski korijen **mg̊h₂-* 'velik' kao i npr. latinska riječ *magnus* 'velik', grčka *mégas* (μέγας) 'velik', sanskrtska *mahā-* 'velik' (odatle *maharadža*, doslovno 'velik kralj'). Izvorno bi značenje latinske riječi *magister* bilo 'velik u odnosu na druge'.

Latinska riječ *magister* u talijanskome se razvila u *maestro* sa značenjem 'vođa orkestra, dirigent, skladatelj', a iz talijanskoga je posuđena i u hrvatski.

Figure 9: The explanation of the etymology of the word *ministar* (minister) from *Hrvatski jezik*.

6. Conclusion

One of the most important characteristics of *Mrežnik* is that it is a web-born dictionary and thus is created as a hypertext document. This means that it has numerous internal and external links to other entries in *Mrežnik* and to other language resources. Table 15 shows internal and external links in *Mrežnik* and their prototypal linking to the sense or to the lemma. Compounds and derivatives are mostly linked to the lemma, but in some cases they have to be linked to a particular sense, e.g. the entry *bilježnica* means 'notebook' and 'female notary'. The adjective *bilježničin* 'belonging to the female notary' can be derived only from the second meaning of the word *bilježnica*. Terminology is usually linked to the lemma as the specific terminological meaning does not correspond to any sense of the entry. However, in some cases as in the example of the entry *broj* above, it can be linked to a particular sense.

LINKS			
internal		external	
to the sense (prototypical)	to the lemma	to the lemma (prototypical)	to the sense
synonyms, antonyms, hyponyms, meronyms, male/female pair, co-hyponyms	compounds and derivatives	verbal valence, collocations, metaphors, terminology, language games	terminology, <i>Croatian Grammar</i> , <i>Croatian Orthography Manual</i> , journal <i>Hrvatski jezik</i>

Table 15: Links in *Mrežnik*.

However, we constantly posed ourselves the question: Is the dictionary linked to a

certain repository because it is possible or because it is useful? The answer to this question is reflected in each *Mrežnik* entry, and many possible links were not made because we did not consider them useful enough. Table 16 shows the position of different language resources in the structure of *Mrežnik*:

EXTERNAL RESOURCES			
incorporated into the entry		links	
developed in parallel with the <i>Mrežnik</i> project	developed independently	developed in parallel with the <i>Mrežnik</i> project	developed independently
language advice for children, idioms, pragmatic note	language advice, Croatian equivalence for Anglicisms	ethnics and ktetics, conjunctions, language games	verbal valence, collocations, terminology, metaphors, <i>Croatian Grammar</i> , <i>Croatian Orthography Manual</i> , journal <i>Hrvatski jezik</i>

Table 16: External resources in *Mrežnik*.

There are also plans for future linking of *Mrežnik* content to other Croatian dictionaries (e.g. dialectal dictionaries, jargon dictionaries) and also dictionaries of other languages, a sign language dictionary, speech synthesizer, sentiment analyser¹⁹, etc. Ensuring stability of links will not create a problem, as all the linked resources are those created and maintained by the Institute of Croatian language and linguistics in which *Mrežnik* is being compiled.

7. Acknowledgments

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¹⁹ See Mihaljević, J. in print.

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