Using authentic texts for grammar exercises for a minority language

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Abstract

This paper presents an ATICALL (Authentic Text ICALL) system with automatic visual input enhancement activities for training complex inflection systems in a minority language. We have adapted the freely available VIEW system which was designed to automatically generate activities from any web content.

Our system is based on finite state transducers (FST) and Constraint Grammar, originally built for other purposes. The paper describes ways of handling ambiguity in the target form in the exercises, and ways of handling the challenges for VIEW posed by authentic text, typical for a minority language: variations in orthography, and large proportion of non-normative forms.

1 Introduction

This paper presents an implementation of an ATICALL (Authentic Text ICALL) system with automatic visual input enhancement activities for students acquiring complex inflection systems. The system, called VIEW, was originally designed to automatically generate activities from any web content for English, Spanish and German (Meurers et al., 2011), and an adaption of the browser-extension version of the program for Russian was presented by Reynolds et al. (2014). We have adapted and implemented the web-version of the program for North Saami.

Adapting the ATICALL-program to a morphology-rich minority language with a short tradition of literacy, like North Saami, gave us challenges like finding suitable texts on the internet, and finding ways of handling both variation in orthography and large proportions of non-normative forms in the texts, in addition to making solutions for using also ambiguous grammatical forms as target words for the exercises.

The paper is structured as follows: Section 2 presents the background and motivation for our approach and puts it in a wider context. Section 3 presents the system and how it was adapted to North Saami. Section 4 discusses how we adapted the system to handle challenges related to the situation for this minority language. Section 5 contains a user evaluation, and in section 6 we present the conclusion. Finally, in section 7, we present some future perspectives.

2 Background

2.1 North Saami

North Saami is a morphology-rich language, with nominal inflection for two numbers, six cases, and possession. Nouns have paradigms both with possessive declension and without possession indicated (absolute declension), see table 1. Verbs have 45 finite forms including three persons for singular, dual and plural, in four modi (indicative, imperative, conditional, potential), and two tenses for indicative. The verbs are also inflected for ten different non-finite forms. Nouns, adjectives and verbs may be divided into groups according to stem type, each type having different paradigms. Suffixation is accompanied by phonological alternations, one of these alternations is a stem consonant alternating process, consonant gradation, where each stem may appear in two or even three versions, e.g. *gieht-, gieđ-, giht-* ("hand-"), as in table 1. Usually, the case suffix is sufficient to identify the case form, but for some common forms, consonant gradation is the only distinguishing feature be-

Lene Antonsen and Chiara Argese 2018. Using authentic texts for grammar exercises for a minority language. *Proceedings of the 7th Workshop on NLP for Computer Assisted Language Learning at SLTC 2018 (NLP4CALL 2018)*. Linköping Electronic Conference Proceedings 152: 1–9.

tween the forms, like for *giehta, gieđa* in table 1. See Sammallahti (1998) for more information about the language.

Number and case	Even stem	Odd stem	Contracted stem
Singular:			
Nominative	*giehta*	*beana*	*suolu*
Accusative	*gieđa*	*beatnaga*	*sullo*
Illative	*gihtii*	*beatnagii*	*sullui*
Locative	*gieđas*	*beatnagis*	*sullos*
Comitative	*gieđain*	*beatnagiin*	*sulluin*
Plural:			
Nominative	*gieđat*	*beatnagat*	*sullot*
Accusative	*gieđaid*	*beatnagiid*	*sulluid*
Illative	*gieđaide*	*beatnagiidda*	*sulluide*
Locative	*gieđain*	*beatnagiin*	*sulluin*
Comitative	*gieđaiguin*	*beatnagiiguin*	*sulluiguin*
Essive	*giehtan*	*beanan*	*suolun*
In English	"hand"	"dog"	"island"

Table 1: Absolute declension of nouns in North Saami, for the three different stem types. The accusative and genitive cases are syncretic.

North Saami has approx. 20 000 speakers living in three countries, Norway, Sweden and Finland, and got a common orthography in 1978. The language is taught as native and foreign language in school and universities.

2.2 ICALL for North Saami

There are other ICALL systems for North Saami, which generate question-answer pairs with fill-in-the-blank (Antonsen et al., 2013) and question-answer drills with to some extent free input (Antonsen, 2013b). They use finite-state transducers, which make it possible to generate a virtually unlimited set of exercises, and they cover all types of combinations of stem types and inflection forms, also those which are infrequent in the texts electronically available.

Despite the availability of the question-answering systems, we still think that also an ICALL program based on authentic texts would be useful for the learners. The advantages of this new system are interesting topics for learners, more context for the exercises, and more variation in sentences with focus on frequent forms and idioms.

2.3 Based on VIEW

The system architecture is based on the VIEW (Visual Input Enhancement of the Web)[1] system described in (Meurers et al., 2011). VIEW is an ATICALL system designed to help learners in their language learning process, and it automatically produces exercises based on a text chosen by the user on the web.

Figure 1: The topic is nouns: all the target words are highlighted.

VIEW includes four different types of activities. Two activities are based on the assumption that noticing is necessary in language learning for adults (Schmidt, 1990). The learner is fist exposed for the grammatical forms: the `highlight`-activity adds colour to target wordforms, as in figure 1. The next step is when the learner looks for the forms: the `click`-activity allows the learner to find the target wordforms in the text and colorize them by clicking them.

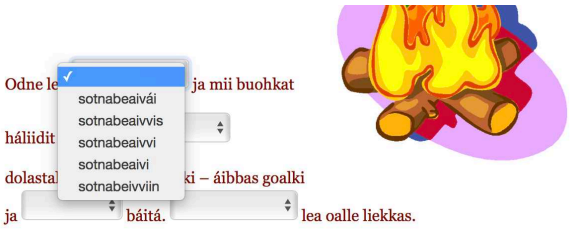

Figure 2: The topic is nouns. The activity is to select the correct form of the target words.

The `multiple-choice`-activity allows the learner to select the correct form from a multiple-choice list, as in figure 2, and in the `practice`-activity the learner types in the wordforms. The latter will be referred to as the `cloze`-activity in this paper. The learner gets instant feedback on whether the answer is correct or not. The activities can be accessed as a web application.

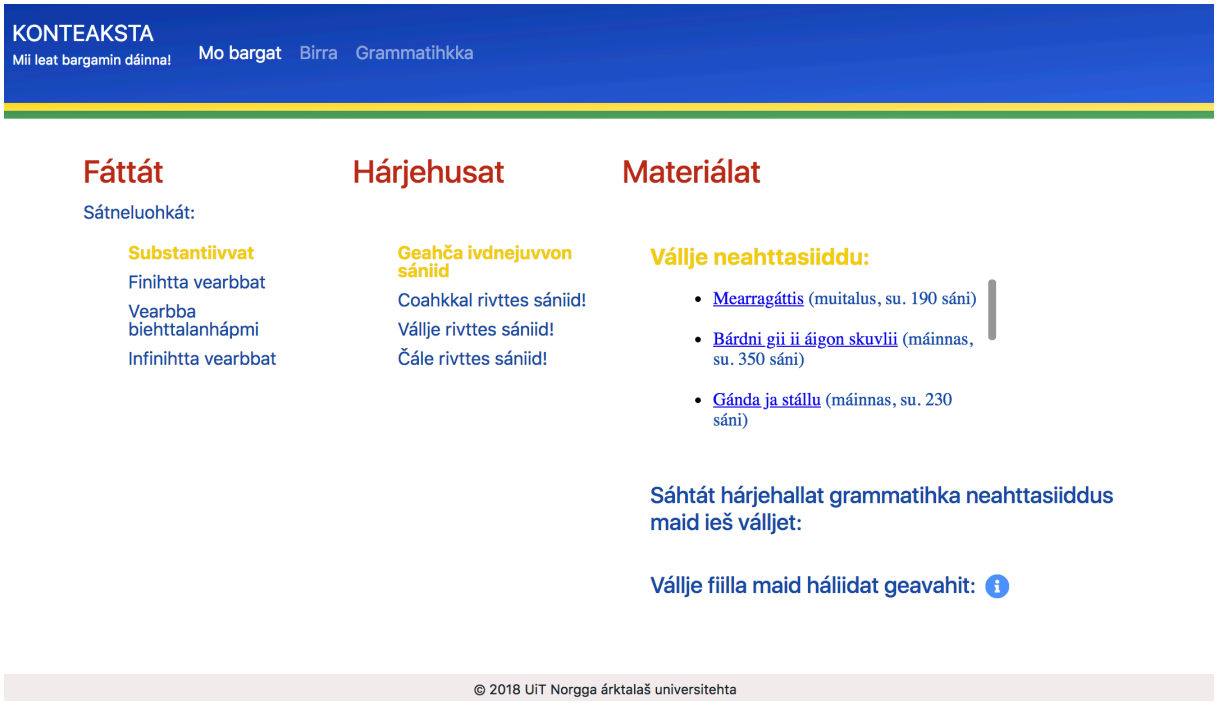

Figure 3: Application home page, where the user can select a grammar topic from the list under Fáttát ("Topics") and an activity from the list under Hárjehusat ("Excercises"). Both of these are explained in section 2.3. From the list under Materiálat ("Materials") the learner can also choose to work with recommended web-texts, a function explained in section 4.2. Below the list there is an expand/collapse menu for adding a URL or uploading a text.

3 Implementation for North Saami

In Konteaksta[2], our implementation for North Saami (home page in figure 3), the user can choose to train her skills on four different grammatical topics:

1. Nouns
2. Finite verbforms
3. Non-finite verbforms
4. Negation form of verbs

These topics are made for the four standard VIEW activities, see 2.3. The user is then presented with three different options:

1. Choose from a set of recommended texts
2. Insert a URL of her own choice, or find one by using the "Google search" field.
3. Upload a file (explained in section 4.2).

3.1 Linguistic framework

The NLP resources being used are developed at UiT The Arctic University of Norway. They include morphological analysers implemented as finite-state transducers (FST) and compiled with the Xerox compilers TWOLC and LEXC (Beesley and Karttunen, 2003).

The syntactic parser for disambiguation and adding function tags is built within the Constraint Grammar-framework (CG) (Karlsson et al., 1995). The CG-framework is based upon manually written rule sets and a syntactic analyser which also selects the correct analysis in case of homonymy. Vislcg3 (VISL-group, 2008), a new improved version of the initial CG compiler (Karlsson, 1990; Karlsson et al., 1995), is used for compilation of the rule sets.

The North Saami analyser recognises 98% of the words in Saami texts (Antonsen and Trosterud, 2017), and has an F-score of 0.99 for part-of-speech (PoS) disambiguation, 0.94 for disambiguation of inflection and derivation, and 0.93 for assignment of grammatical functions (Antonsen et al., 2010).

3.2 Technical implementation

Our application front page is written in HTML and Javascript. Once all options have been

[1]The open-source research prototype is available at http://purl.org/icall/view

[2]http://oahpa.no/konteaksta/

chosen (topic, activity and webpage) the Java servlet will execute the following three steps:

1. Preprocessing. During this step the textual content from the webpage is extracted and tokenised. Then sentence boundaries are detected.
2. The text is annotated with the grammatical analyser.
3. Postprocessing. Here the target words are selected, and the HTML code is enhanced with additional attributes.
4. Loading. The enhanced page is loaded to the browser. The four different exercise types are implemented in Javascript.

One main technical issue we are facing in developing the application lies in the tokenization for sentences ending with abbreviations, as for measures, cf. "cm." in example (1). These sentences get an extra dot not present in the original text as sentence delimiter for the syntactic analysis, and this sometimes creates problems when putting each token back in its original position after it has been analysed:

(1) Darfi berrešii leat assái, 15-25 cm.
The turf should be thick, 15-25 cm.
Darfi deaddá ...
The turf pushes ...

As a consequence, in the text after these abbreviations, the wrong tokens are highlighted. This happens for all activities. In figure 4 nouns should be highlighted, but after the token "cm", the tokens "." and verb "deaddá" are highlighted instead of the noun "Darfi".

Darfi berrešii leat assái, 15-25 **cm.** Darfi **deaddá**

Figure 4: The output from the application when highlight-activity for nouns is chosen with text containing an abbreviation in the end of the sentence. Translation is in example (1).

This is something we are currently working with.

To take into account variation in orthography, we allowed the application to accept more forms in the cloze-activity, see 4.4 for a more detailed explanation.

To help the user focus on the text itself, we have removed the enhancement of targets in menus in the webpages (by searching and removing the enhancement from specific HTML-tags).

After initial testing, we realised that one limit of the application is its performance in terms of response time (especially for the multiple-choice and cloze activities). This was improved by the following: before the preprocess is executed the application checks whether a file with annotated text exists; if it does, only the postprocessing and loading steps are executed; if not, the output from the preprocessing is saved to a file for future use. In this way, the process is now twice as fast as before.

4 Challenges for a morphology-rich minority language

In the VIEW-versions for English and German the key-answer is the form used in the original text, which the activity is based on (Meurers et al., 2011, 13), and this is also the situation for Russian, except from the generating of words with stress marking, which is not a part of Russian orthography (Reynolds et al., 2014, 102).

For a morphology-rich language with much variation like North Saami, we chose to generate the key-answer, based on the morphological analysis of the target word, and in many cases the system will accept several answers. This is important both for target selection (section 4.1), and for variation and misspellings (section 4.4).

For a minority language there are also challenges in finding suitable web-texts (section 4.2), and there is often a mix of both the minority and the majority language in the web page (section 4.3).

4.1 Target selection

Each noun declension paradigm has 11 cells, see table 1. In the multiple-choice and cloze-activities it is not always obvious for the learner which form to choose. If there is no agreement with another member of the sentence, e.g. subject-verbal agreement, the learner will not know whether the target should be in singular or plural if there is no picture as reference. The Russian VIEW does not select tokens for which number is grammatically ambiguous (Reynolds et al., 2014, 102).

In our first version of the program we solved the problem by dividing singular and plural nouns into two target types, so the learner would choose to work with either nouns in singular or nouns in plural. But two of the cells in the case paradigm always have homonymous forms across numbers: singular comitative and plural locative, e.g. *gieđain* (Sg.Com: "with the hand" or Pl.Loc: "in the hands"). The analyser does not always succeed in choosing correctly between these two analyses, so there is a risk of using a plural target when the learner has chosen a singular activity, or the other way round. The learner is never exposed to the morphological analysis of the wordforms, so by including both singular and plural nouns in the same target set, a wrong analysis will not make any difference for the user, because the wordform is the same. The essive case has no number marker, and with this solution we were able to include the essive case in the activity.

For our new solution for the number ambiguity, we are generating the distractors for multiple-choice with an algorithm according to the analysis of the target word: the distractors will have the same number, but different case, as the target word. Essive can be distractor for both singular and plural. Only for target words in nominative case, which agree with the verb, the system might offer both the singular and the plural form. For the cloze-activity the system will accept both singular and plural forms if the target word has no agreement with the verbal, e.g. in example (4), as the object is accepted both *gándda* ("boy.Sg.Acc") and *gánddaid* ("boy.Pl.Acc").

4.2 Finding suitable texts

According to Meurers et al. (2011), the idea behind the VIEW approach is to allow the learner to choose up-to-date webpages on any topic they are interested in, because this clearly has a positive effect on learner motivation. Learners can use an ordinary search-engine interface to search for texts, or enter the URL of the page they want to enhance.

This is a good idea, but problematic for a minority language like North Saami. There are texts on the web, but the high rate of misspellings, 4% (Antonsen, 2013a), is problematic for getting reliable morphological analysis and disambiguation. Misspellings in ATICALL texts are also pedagogically problematic, since learners will be exposed to them.

Traditionally Saami speakers write in the majority language, and a native speaker's residence is decisive for the amount of schooling she has had in Saami, even if the situation has improved to some extent over the past 25 years. Still, native speakers are not exposed enough to the written language to be able to automate writing. According to research most L1 pupils both read and write better in majority language than Saami language (Helander, 2016, 15–16). Therefore Saami web-texts tend to be short, and with many misspellings.

There is a North Saami daily newspaper, but its web articles are behind a paywall. The Norwegian Saami broadcasting company (NRK-Sápmi) publishes a couple of new texts every day in North Saami, on topics which could be interesting for learners, but our analysis of 1.6 mill. words of these texts gives the rate of 5.7% misspellings, which is even higher than the average rate. That means that almost every sentence contains a misspelling. Also the texts published by the Finnish broadcasting company, YLE Sápmi, contain many misspellings.

Our solution is using texts from textbooks published on the web, and giving links to these texts as "recommended texts", see figure 3. In addition to news articles, NRK-Sápmi has published a collection of fairy tales, and they are willing to correct the texts on their site, if we proofread them. At this point it is not possible for the learners to choose up-to-date webpages on any topic they are interested in, because we have to ensure the quality of the spelling. There is a spell checker for North Saami, but it detects only non-word errors, and the correction suggestions are not chosen according to the context. An automatic spelling correction would not give the required quality.

Another way of getting around this problem has been to implement the possibility for teachers to upload proofread material or their own texts. They may then send the URL for each activity to their students.

4.3 Majority language in the texts

Even if there are good texts in North Saami on the web, they often contain fragments of the majority language (Norwegian, Finnish, Swedish), like a menu, or a dateline, as in example (2), with a dateline in Norwegian.

(2) Publisert 19. jan. 2018 kl. 09:32
Published 19. Jan. 2018 o'clock 09:32

We can remove the enhancement of elements which are specified in the HTML-code, like menus, but elements like datelines are not always specified. If none of the tokens are recognised as North Saami words, they do not constitute a problem for the ICALL-program. But this is something we have to keep an eye on, and it may require implementation of a language recogniser in the pipeline.

4.4 Handling variation

The orthography often allows variation in the spelling and the morphology. For example, the North Saami copula singular 3rd person indicative past tense has two normative orthographic forms, *lei* ~ *leai*. Also in other parts of the morphology there is much variation, e.g. the suffix for first person plural form of odd-stemmed verbs can, due to dialectal differences, be both *-it* and *-at*, like in *muitalit* ~ *muitalat* ("(we) tell"). The cloze-activity must accept all normative forms, and our solution is to generate the correct form(s) based on the analysis of the target word.

Also, we have solved the problem of non-normative forms in the same way. The descriptive analyser can to some extent recognise a word with non-normative spelling, but to get the key-answer to follow the normative spelling, the target form must be generated. In example (3), the verb *áiggon* ("(I) will") is spelled like it is pronounced in some dialects, and the analysis from the analyser is *áigut+V+TV+Ind+Prs+Sg1*. With these tags the normative form, *áiggun*, will be generated as the key answer for the cloze-activity, and the wordform *áiggon* will not be accepted as a correct answer.

(3) …ja mon áiggon [áiggun] jearrat
…and I will.Prs.Sg1 [will] ask
dus čiežanuppelohkái gažaldaga
you seventeen questions

The morphological and syntactic analysers for the ICALL-program are also used for the machine translation system described in Antonsen et al. (2017). This system is facing the same problem with non-normative forms in texts, and thus the work aimed at giving the descriptive analyser a better coverage for machine translation of North Saami web-texts, is also giving a better coverage to the analysis of web-texts for the ICALL-application.

4.5 Better feedback to the user

The VIEW system provides limited feedback to the user. In all the three activities where the user is asked to "do" something (click, choose, cloze), the answer turns red if it is wrong or green if it is correct. We have looked into how to give more sophisticated feedback to the user in the multiple-choice and cloze-activities. As suggested by Reynolds et al. (2014), one may give meaningful feedback based on the same NLP techniques as employed in the analysis, see figure 5.

```
"<De>"
    "de" Adv @ADVL>
"<boahtá>"
    "boahtit" V IV Ind Prs Sg3 @+FMAINV
"<stállu>"
    "stállu" N Sem/Hum Sg Nom @<SUBJ
"<ja>"
    "ja" CC @CVP
"<áigu>"
    "áigut" V IV Ind Prs Sg3 @+FAUXV
"<váldit>"
    "váldit" V TV Inf @-FMAINV
"<gándda>"
    "gánda" N Sem/Hum Sg Acc @<OBJ
"<.>"
    "." CLB
```

Figure 5: The FST and CG analysis of the sentence in example (4). The function tag for subject (SUBJ) is marked with an arrow towards the agreement verb, and both the object (OBJ) and adverbial (ADVL) are marked with an arrow towards the main verb (MAINV). The verb *váldit* has the analysis *váldit+V+TV+Inf* ("Verb+Transitive+Infinitive").

(4) De boahtá stállu ja áigu váldit
Then comes the troll and will take
..... (gánda)
..... (the boy)

For many of the targets, it would be possible as a first feedback to an incorrect answer, to **highlight** in blue a word as a hint for choos-

Figure 6: An example of highlighting a hint to the learner. The hint is the transitive verb *váldit*, which triggers the accusative case for the object, and the correct form is *gándda* ("boy.Sg.Acc"). The sentence is translated in example (4).

ing the correct form, like in figure 6, the verb *váldit* triggers the accusative case for the target word.

Usually the verb is the trigger for the case in the adverbial, moving towards a place (illative), or from a place (locative). For some of the oblique cases, the trigger will be a governing verb, like *ballat* ("to be afraid of") for locative or *liikot* ("to like") for illative. These verbs can be marked with an additional tag in the analysis, because the CG-grammar already contains sets of such verbs. For the nominative the hint is the verb agreeing with the noun.

For some of the non-finite verbforms, the trigger is an auxiliary verb, such as the copula for the perfect participle, e.g. in *lea borran* ("have eaten"). For infinitive the trigger may be an auxiliary (like *áiggun*) or a verb governing the infinitive (like *vikkan*): *áiggun borrat* ("(I) will eat") or *vikkan borrat* ("(I) try to eat"). The negation form of the main verb is preceded by the negation verb, inflected for person and number: *in bora* ("(I) don't eat"). Even though the negation form is a non-finite verb form, we considered it to be both important and difficult to learn to inflect correctly, especially for learners with a Germanic language as their first language, so we have included it as a target type of its own.

For the finite verb-form there is often a subject agreeing with the finite verb, but not always, since the subject may be omitted. But it seems that often it will be possible to identify and highlight a hint, and based on this, one might also generate a comment, like *"Look at the highlighted subject, the verb must agree"*. These are plans, and are not implemented yet.

5 User evaluation

We have identified two main user groups: teachers and learners. A group of teachers at an upper secondary school has started using the application and has given us some initial feedback, which we have taken into account.

They suggested that it would be good to have additional information about the texts recommended by us. We added genre, length and difficulty level on each link to the texts.

Upon their request, we have removed the possibility to display key-answers from the exercises, since they were concerned that this feature might be used too much by the students, instead of trying to give the correct answer themselves. We also added information on how to convert PDF files into HTML (the format accepted by the application for file upload).

In addition to this, we asked both the students and the teacher at an introductory course in North Saami at a university to evaluate our application by replying to a targeted set of questions. They are still at the beginning of their course, but the teacher is confident that towards the end of the first semester the application will be useful and will provide exercises suitable to their level. In addition, the teacher says that is good for the students to train grammar in context, and read a variety of texts.

To the question about what should be improved, the teacher asks for more recommended texts. However, finding suitable texts for a minority language like North Saami is problematic (see 4.2).

We received feedback from three students using our application. All of the students are L2 speakers. Two of the three students have used at least two texts and at least three out of four of the activities proposed.

Two of the students declared that they had to struggle a bit before understanding how to use the application. In fact, one of the students noticed that it would be helpful to be able to use the same text for all topics. This confirms that, at least some of the users don't understand that it is possible to produce the desired exercise for each text. This means that we might rethink the layout of the application, but in order to do that it would be helpful to have more detailed feedback. One possibility to get a more explicit feedback might be to plan a short "usage session" with some users and get their instant opinions about the application, as was done by Bontogon et al. (2018).

Although the students like using the application to add variety to their study, two of them found the texts too difficult for their level of knowledge of the language.

In addition, a bug was reported, which caused the application not to show any correct/incorrect feedback when using the application together with a translation plugin. This has been fixed.

6 Conclusion

In this paper, we show that it is possible to adapt an ATICALL program like VIEW for North Saami. The analyser tools available are quite robust and with an acceptable F-score, but adapting and implementing the application for a minority language present some extra challenges.

The amount of variation in orthography made it necessary to generate the key-answer instead of using the original text. The same applied for misspellings. But the high rate of misspellings makes the analysis less reliable, and the ATICALL approach less pedagogical for learners, because they are exposed for the misspellings. Generating the key-answer makes it possible also to accept more morphological forms, and allows us to include also ambiguous target words.

It is also clear that although we provide the user with the feature of choosing any webpage, there are not enough suitable web-texts available of acceptable quality. The solution is thus to use proofread material, either as recommended web-texts or as teachers' uploaded texts. Still this ATICALL program was welcomed by students and teachers in both schools and universities, because of the sparseness of learning materials.

7 Future work

From the initial feedback received from students, we identified some problems with regards to the layout. In order to improve it and make it more user-friendly, we plan to organise a "usage session" with students to get instant opinions and comments about their experience with the application.

As described in 4.5, we plan to implement additional feedback, by highlighting hints in the sentence, if the learner writes or chooses an incorrect wordform. Based on the hint it would also be possible to generate comments for the learner.

We want to add adjectives as a target type. The inflection and derivation of adjectives is an important part of the grammar, and we are searching for suitable texts for this.

We have implemented three additional topics: identification of subject, object and adverbial. These are currently under testing, but we plan to have them in the stable version of our application soon, for both the highlight-activity and the click-activity. These additional topics will be relevant not only for language learners, but also for students following linguistic courses for North Saami as a native language.

We will concider implementation of a language recogniser in the pipeline, because there are often fragments of the majority language in the Saami webpages.

Acknowledgments

Thanks to Heli Uibo, who created the first implementation of VIEW for North Saami, which our work builds on. We also thank Ciprian Gerstenberger for technical support, and Trond Trosterud for useful discussions.

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