

# A Knowledge Base Supporting the Assessment of Language Impairment in Bilingual Children

Dana Hakman

Department of Computer Science  
Vrije Universiteit Amsterdam  
dana.hakman@student.auc.nl

Victor de Boer

Department of Computer Science  
Vrije Universiteit Amsterdam  
v.de.boer@vu.nl

C erise Muller

Applied Linguistics  
Vrije Universiteit Amsterdam  
cerise.m@live.nl

Petra Bos

Applied Linguistics  
Vrije Universiteit Amsterdam  
phf.bos@vu.nl

## 1 INTRODUCTION

There are approximately 6,000 languages in the world being spoken in a little less than 200 countries, thus, it seems like monolingualism is the exception rather than the rule [1]. Even in monolingual countries, the number of bilingualism is raising mostly due to globalization and immigration. It has been estimated that majority of children worldwide learn two languages before puberty. Thankfully, many studies have shown that bilingualism has multiple positive effects on childrens development. If children develop both languages throughout their primary school years and achieve a native-like ability in both languages it can help them develop more flexibility in their thinking as a result of processing two languages at once [3]. However, bilingualism can also cause some difficulties. Since children develop two languages at an early age, they seem to be less fluent in both languages. Their study has shown through verbal fluency tasks that monolinguals get higher scores than bilinguals which seems logical because monolinguals only have to retrieve vocabulary from one language system. Learning more languages means you have to get acquainted with multiple types of grammar, multiple vocabularies and so on. This may cause for bilinguals to make errors such as code-switching - a phenomenon that occurs when someone uses two languages within a single discourse, sentence or constituent [4]. Children who are still learning both languages can make errors within words and grammar as well. They may transfer rules from one language into the other - for example, when one language contains a complex linguistic system while the child has already acquired a basis from the other language [5]. Because bilingualism often comes with errors it is difficult to diagnose if a child has a language impairment or if the errors come from being less fluent in both languages. Especially for speech therapists who only know one out of two (or more) languages, it can be a difficult task. To make it easier for them it would be helpful

to create a knowledge base with knowledge on some minority languages in the world. At this moment, this knowledge base exists in a Wikipedia-type of website.<sup>1</sup> It started as a project by Petra Bos - professor at VU University Amsterdam - where every year a couple of languages were added. By now, the website has become a helpful tool for speech therapists all over the Netherlands. However, due to the amount of information, it contains it has also caused for less structure. In this research, the goal is to develop a knowledge base with information on common minority languages spoken in the Netherlands that has a clear structure and is user-friendly. The research question focuses on how to improve the existing knowledge structure to help speech therapists work with bilingual children that have a possible Specific Language Impairment (SLI) diagnosis. This is achieved by focusing on what type of information is necessary for speech therapists and how that information flows through the knowledge base. Hopefully, the information that is gained during this study will help create a well-structured and easy website for speech therapists and clinical linguists to use when trying to diagnose a bilingual child.

## 2 METHODS

As mentioned before, the focus of this research is to improve an existing wiki page which contains an overload of information into a structured website in which the information flow is concise and easy to access. This research was carried out as an iterative user-driven design process. This iterative design process consisted out of three user tests that were conducted with participants out of the field of linguistics over a period of six months. The first iteration of the user test aimed at getting a deeper understanding of the target group and creating a first prototype as a result. The second iteration of the user test aimed at evaluating and improving the first prototype. This resulted in an improved version of the prototype. The third iteration of the prototype aimed at evaluating the second prototype. The results of this third iteration of user-driven design formed the structure of the final product. The starting point of this research was the existing knowledge base which had the structure as shown in Figure 1. This initial information architecture was rather flat, with many items on the same page which made it difficult to navigate around and find the appropriate information.

---

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).

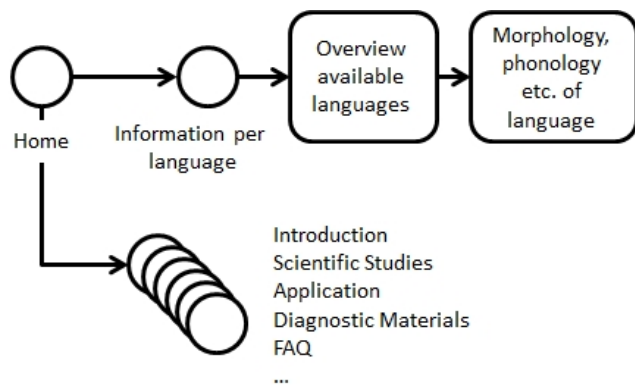
*WebSci'18, May 2018, Amsterdam, the Netherlands*

  2018 Association for Computing Machinery.

ACM ISBN 978-x-xxxx-xxxx-x/YY/MM...\$15.00

<https://doi.org/10.1145/nnnnnnn.nnnnnnn>

<sup>1</sup><http://meertalighedentaalstoornissenvu.wikispaces.com/Welkom>



**Figure 1: Overview of the initial Information Architecture. This is rather 'flat', with many items on the same page**

## 2.1 Target Group

The target group of this design process are individuals who are active in the field of linguistics. As the knowledge base is a website, and thus accessible for everyone, the target group of this research is everyone that makes use of the existing knowledge base or who would like to access it in the future. As it is impossible to know who are exactly in that target group this research has taken speech therapists and clinical linguists of whom the usage of the knowledge base was known by the creator as specified target group. Additionally, some participants were used that were not familiar with the wiki page. These participants were asked through a bachelor course and a seminar.

## 2.2 First iteration

The first user study focused on finding out what the needs of the target group were for the knowledge base. As figuring out what the exact needs are for a knowledge base it was decided to test both current users of the website and individuals who did not use the website yet who are active in the field of linguistics.

For the first user study five interviews were conducted through conference call or in person. The questions that were asked are attached in Appendix 1. The 5 participants were contacts of Petra Bos and were known for having used the website before.

Participant	Function
Participant 1	Speech therapist + clinical linguist
Participant 2	Professor + researcher HAN Nijmegen
Participant 3	Clinical linguist
Participant 4	Speech therapist + researcher bilingualism
Participant 5	Clinical linguist

**Figure 2: First iteration test participants**

At the same time a questionnaire was spread under 18 participants in a seminar on language and hearing. These participants were not all familiar with the website, which made it possible to ask more objective kinds of questions. This questionnaire can be

found in Appendix 2. In this questionnaire the results of the interviews were also added, making the total participant count 23. These participants were all working in 7 of the 12 provinces in the Netherlands which gives it an adequate geographical coverage. 48,3 percent of the participants are speech therapists, 13,8 percent are clinical linguists, 17,2 percent are linguistic researchers and 20,7 percent answered "other" which were mostly students, professors and policy advisors. The main findings of this first iteration were indeed that the structure of the information architecture was inefficient. Participants indicated that it was difficult to navigate around and to find the information quickly. Participants indicated that they mainly used the knowledge base for the page "information per language". The other pages were either never accessed or with a very low frequency. As a result, the first prototype was centered around the information per language, making it the first touch point that users have with the knowledge base. The first prototype can be found in figure 3.



**Figure 3: First prototype of knowledge base**

Of the 23 participants 69,6 percent were already familiar with the existing website. 10,5 percent answered they use it weekly, 31,6 percent uses it monthly, 52,6 percent had visited it on occasion and 5,3 percent never. 78 percent of all the participants have indicated that it is hard to find accurate information on bilingualism and SLI. The participants who use the website mostly use it for 10 minutes at a time, often prior to the meeting with the bilingual child. The page that is used most regularly is the page informatie per taal which contains information on the languages that the website has provided. Within this page there are six segments: 0. Praktische informatie voor taalonderzoek (practical information for linguistic research), 1. Algemene informatie over de taal (general information on the language), 2. Algemene informatie over de taal (specific information on the language), 3. Overzicht van verwervingsvolgorde van bepaalde elementen in de taal (overview of the acquiring a language and specific elements of the language), 4. Indien voorhanden: informatie over specifieke taalstoornissen in deze taal (when available: information on specific SLI elements in this language) and 5. Slotopmerking en literatuurverwijzing (final comments and literature references). These six segments are all used regularly except for the literature part.

The pages on the website that are (almost) never used are diagnostische materialen, FAQs, protocol taalanalyses op AC&A&Zs and

bibliografie/begrippenlijst. When participants were asked what the biggest disadvantages are they answered: visual unappealing, not very manageable, too much information and not enough structure. The question on the advantages of the website was answered that it is a unique source, adequate information and especially information that is hard to find.

### 2.3 Second iteration

For the second user study an improved prototype of the website was built. The second prototype is the result of the evaluation of the first prototype. In this second iteration, ten participants were asked to perform specific tasks in the new knowledge base. The participants were asked to use the Think Aloud method, which required them to tell the researchers why they performed as they did on the tasks. Of the ten participants, 5 participants were students from the bachelor Communication- and Information Sciences but with a major in language and language disorders; these students had never worked with the original website before. The other 5 participants were working in the field of linguistics and/or speech therapy and were more familiar with the original website. Again, the iteration included both users and non-users. The tasks that were developed for the participants can be found in Appendix 3.

Most participants were pleased with the new outline; especially now the searching for languages is a main function on the website rather than one of the many functions. All ten participants evaluated the prototype as a good starting point for improvements. The participants that were familiar with the original Wikipage thought it was better structured than the Wikipage. However, three out of ten participants (30 percent) thought that the choice of font and colors caused for problems with reading. 30 percent of the participants also said that knowledge of the subject is required to know where to find the information that is necessary. 20 percent of the participants answered that there should be a scroll down column per page to see what information that page consists. All feedback that was provided by the participants was used for the development of the second prototype.



Figure 4: Second prototype of knowledge base

The resulting prototype differed in look and feel. The design was made more quiet in order to shift the attention of the users more to the content of the website than the visual design. In addition, the available languages were shown, as it was unclear for the test participants for what languages they could search. In addition,

the structure of the information per language was improved, all available sections were shown in buttons. This aimed at showing the users in a blink of an eye what is available on the website, something that was not possible before.

### 2.4 Third iteration

The third iteration of the design process aimed at evaluating in second prototype. For this last user study, fourteen participants were asked to evaluate the prototype, the questions can be found in appendix 4.

The second prototype was evaluated positively. The relatively flat visual design was found easy on the eye and the clear structure of buttons made it easy for participants to navigate and find the specific information that they are looking for. The second prototype was evaluated as a great improvement from the original wikipage both in usability and usefulness. Constructive feedback was mainly focused towards the type of content on the knowledge base, as participants were missing specific information that they viewed as relevant to the website. As the goal of this research was to improve the structure of the information architecture and not the actual content of the information, this feedback was for now not taken into consideration.

## 3 FINAL PRODUCT

The most common criticism that was voiced had to do with the structure of the website. The information on the website was found accurate and useful, however, it was hard to find. Especially, users experienced it was difficult to find specific information on the website and it took too long to find what was useful. The iterative user-driven design process resulted in an improved information architecture where information can be more easily accessed. Based on the aggregated results from this user study, an improved information architecture has been developed that can be found in figure 5.

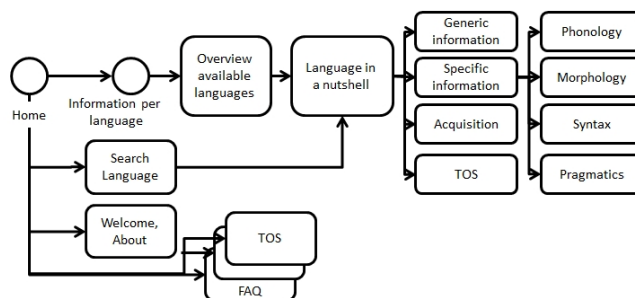


Figure 5: Overview of the improved Information Architecture where information is much more structured and can be accessed in multiple ways (search, browse).

Where the first website was mainly consisted of many pages with a lot of information per page, the new website consists of more depth within the pages. Every language has multiple pages lying underneath the surface to create a more structured knowledge base.

In the older version there is no structure that guides the user to perform a particular task. The updated knowledge organisation is

structured in such a way that the user is always guided to search for a particular language, which is the main task the users perform on the website. In this dynamic prototype the focus is to organise the information in such a way that the most important tasks for the users is the first task in the website, which is selecting the designated language.

In this final product we have shifted the information per language to the home page. In addition, the list of languages that can be found on the website is now a button that can be accessed immediately from the homepage. In addition to the knowledge structure, we have also focused on the visuals of the website, as users indicated that the current visuals were problematic for their user experience. An example of the final product can be found in figure 6. On the right, all sections that are relevant for the information per language are specified in buttons. On the left, a short overview of the designated language is given.

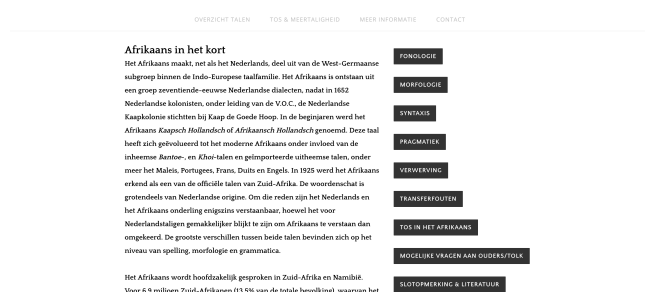


Figure 6: Example of overview of knowledge base for Afrikaans

## 4 DISCUSSION

We here present a case study in improving a collaborative wiki for linguistic diagnostics using an in-depth, structured and user-centric method. This method utilizes extensive user studies with professional users. We show that this approach can identify structural issues at the level of the information architecture as well as the User Interface of a web site.

Such a method can be used for other web sites. this specifically holds for other wiki-like collaborative sites, where over time, information added by contributors has accumulated into large unstructured information architectures. When such documents are to be used by professionals in their tasks, (diagnostic or other), a good information architecture is key[2]. The described method can assist in identifying, improving and evaluating the User Experience for such a digital resource.

This study is completely based on the feedback of speech therapists, clinical linguists and other people working in the field of linguistics. This means that the website is structured in the way these people preferred it, thus, it may not be preferred by others. The importance of this study was to constantly use feedback to improve and restructure.

For future research, it might be interesting to analyze the statistics of the website after a year to see how the website is used and to examine if the users are still satisfied with the improved website.

## ACKNOWLEDGMENTS

This work was supported by an Academy Assistant grant of the Network Institute of Vrije Universiteit Amsterdam (<http://networkinstitute.org>).

## REFERENCES

- [1] S Benedictus. 2015. Meertaligheid in Europees perspectief. *Levende Talen Magazine* 19, 7 (2015), 26–30.
- [2] Petre Botnariuc. 2015. A DIAGNOSIS OF THE USE OF WEB 2.0 TECHNOLOGIES IN GUIDANCE AND COUNSELLING. In *The International Scientific Conference eLearning and Software for Education*, Vol. 2. "Carol I" National Defence University, 102.
- [3] J Cummins. 2001. Bilingual children's mother tongue: Why is it important for education. *Sprogforum* 19 (2001), 15–20.
- [4] S Poplack. 1980. Sometimes I'll start a sentence in Spanish Y TERMINO EN ESPAÑOL: toward a typology of code-switching. *Linguistics* 18, 7 (1980), 581–618.
- [5] L. Verhoeven. 2007. Early bilingualism, language transfer, and phonological awareness. *Applied Psycholinguistics* 28, 3 (2007), 425–439.

## A APPENDIX 1

### Part 1 : Introduction

- Cerise and Dana - Who are we?
- Project description
- > Participants work
- Can you tell us something about your work and who you are?
- What kind of clients do you have?
- What are the most common problems when it comes to bilingualism?
- What is a consultation like? How does that work?
- Part 2: Current situation wikipage
- How often do you use the website?
- Never Once or twice Monthly Weekly
- How long do you use the website in 1 session?
- Short (+/- a minute) Medium 5-10 min Long 15 min Reference > 30min
- Which languages have you visited?
- Have you visited/read the welcome page?
- Have you visited/read the introduction page?
- Have you visited/read the information per language page?
- Have you visited/read the scientific studies page?
- Have you visited/read the implementation science - practice page?
- Have you visited/read the diagnostic materials page?
- Have you visited/read the protocol-language analysis page?
- Have you visited/read the FAQ page?
- Have you visited/read the references and glossary page?
- Do you use the search bar to navigate on the website?
- How do you search on the website? (Describe your whole search query)
- Part 3:
- Do you use the website live in a consultation or as reference afterwards?
- want to know which segments in the information per language page is useful and how often you use it:
- Practical information for linguistic research:
- General information on the language
- Specific information on the language
- Overview of the acquiring a language and specific elements of the language
- When available: information on SLI in this language
- Final comments and literature references
- We would also like to ask some open-ended questions:
- Current use: Benefits of the wikipage?
- Current use: Disadvantages of the wikipage?
- Part 3: Future possibilities for website / new design:
- As seen from the disadvantages: what is missing?
- From the users perspective: what would be convenient additions?
- Additional suggestions?
- Finally, would you like to cooperate more often in the future for this study? Possibly to evaluate the end result?

## B APPENDIX 2

User study Meertaligheid en Taalstoornissen Wikipagina:

- In which region are you working? In welke provincie bent u werkzaam? (Multiple options are possible)
- What is your position in the field?
- Speech therapist
- Clinical linguist
- Linguistics researcher
- Other:
- Are you familiar with the Wikipage Meertaligheid and Taalstoornissen?
- Yes
- No (Continue with question 14)
- How often do you use the website?
- Weekly
- Monthly
- Have visited it once or twice
- Never
- How long do you use the website in 1 session?
- Short (1 minute)
- Medium (5-10 minutes)
- Long (15 minutes)
- Reference (>30 minutes)
- Which of the following pages have you visited once or twice? (multiple options are possible)
- Welkomspagina (welcome page)
- Introductie (introduction)
- Informatie per taal (information per language)
- Wetenschappelijke studies (scientific studies)
- Toepassing wetenschap-praktijk (implementation science-practice)
- Diagnostische materialen (diagnostic materials)
- Protocol taalanalyse op AC&Auml;Žs (protocol language analysis)
- Veelgestelde vragen (FAQ)
- Bibliografie/begrippenlijst (references and glossary)
- Which of the following pages have you visited regularly? (multiple options are available)
- Welkomspagina
- Introductie
- Informatie per taal
- Wetenschappelijke studies
- Toepassing wetenschap-praktijk
- Diagnostische materialen
- Protocol taalanalyse op AC&Auml;Žs
- Veelgestelde vragen (FAQ)
- Bibliografie/begrippenlijst
- Which of the following pages have you never visited? (multiple options are available)
- Welkomspagina
- Introductie
- Informatie per taal
- Wetenschappelijke studies
- Toepassing wetenschap-praktijk
- Diagnostische materialen
- Protocol taalanalyse op AC&Auml;Žs
- Veelgestelde vragen (FAQ)
- Bibliografie/begrippenlijst
- Which languages have you visited? Which segments of the page informatie per taal do you use?

Praktische informatie voor taalonderzoek (Practical information for language research) Algemene informatie over de taal (General information on the language)

Specifieke informatie over de taal, met name fonologie, morfologie, syntaxis, pragmatiek (Specific information on the language (phonology, morphology, syntax and pragmatics))

Overzicht van verwervingsvolgorde van bepaalde elementen in de taal (Overview of the order of acquisition of specific elements in the language)

Indien voorhanden: informatie over specifieke taalstoornissen in deze taal (When available: information on specific SLI elements in this language)

Slotopmerking en literatuurverwijzing (Final comments and literature references)

- What are possible advantages of the current wikipage?
- What are possible disadvantages of the current wikipage?
- What is missing on the current wikipage?

Go to question 18

- Do you often have issues with bilingualism in your field of work?

Yes

No

- Do you find it difficult to get information on this subject?

Yes

No

- Could you use a website that describe and explain some minority languages in the world (in Dutch)?

Yes

No

- What kind of information would you like on a website like that?

- Do you have any additional suggestions?

- Would you like to cooperate with further research on this matter? For example, when a prototype is being built? If so, leave your email address below.

## C APPENDIX 3

For the second user study, we have created a prototype of the renewed website. This means that we have created an offline example of how the website could be built. Before building the website as this example, we feel it is important to hear the opinions of the people that have to work with the website. We have decided to test one language in the prototype before creating the website, to see if it works in this format. To effectively use the website, we have created some tasks for you to do. We would like you to answer one of the three multiple-choice answers and to explain your choice. On the basis of your feedback we can eventually develop the final website.

Start: <https://xd.adobe.com/view/9d195353-80b1-40ff-b50c-1b96174a9735/>

Task 1: Press the red button Overzicht talen and select the language French. a. Pleasant b. Neutral c. Unpleasant Explanation:

Task 2: You are trying to find what a French 2-year old child should be able to do. Try to find this on the website. a. Easy to find b. Neutral c. Hard to find Explanation:

Task 3: You want to know the word order that is used in French. Try to find this on the website. a. Easy to find b. Neutral c. Hard to find Explanation:

Task 4: You want to know why the website was created. Try to find this on the website. a. Easy to find b. Neutral c. Hard to find Explanation:

Task 5: You want to know more about French dialects. Try to find this on the website. a. Easy to find b. Neutral c. Hard to find Explanation:

Task 6: You want to know where the information came from. Try to find this on the website. a. Easy to find b. Neutral c. Hard to find Explanation:

- Additional comments and/or advice:

## D APPENDIX 4

Dear sir, madam,

The last couple of weeks we have been busy with processing the feedback we have received in our previous user studies to create the website on bilingualism and SLI. You have participated in our user studies before and agrees to help us with future user studies. The new interface of the website is different from the prototype, thus, we ask you to not compare them to each other. We would rather have feedback that is based on the current website.

The current URL of the website is: <https://meertaligheidentaalstoornissenvu.wiki>

For now, it consists of only three languages to find out if the website works with the interface it has now. If the feedback is (mostly) positive, we will expand the website with all the languages and information that the previous wikipage had.

Our question this user study is: Could you take a look on the website, use all the options it has, visit all the pages we have now, and let us know: What is your first impression? Is it an improvement of the previous website (<http://meertaligheidentaalstoornissenvu.wikispaces.com>, answer this question only if you are familiar with the website)? Is it an accurate tool to use with bilingual children with possible SLI diagnosis? Do you have any additional feedback and/or advice?

Kind regards, C erise Muller and Dana Hakman