



UNIVERSITY OF GRONINGEN

BACHELOR THESIS

Using Visualization and Gamification methods to Provide Feedback to Learners

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Abstract

The goal of this project is to help the language learners to progress in their studies by implementing a web based visualization component that will provide the learners with the feedback about their progress in acquiring the vocabulary of a second language, which they are learning. In addition, the aim of this project is how using gamification methods to make interesting and entertaining experience for the user, while the user is using this web based visualization component and the website itself.

As it was hoped the impact of the dashboard on the behavior of the learners is positive. The feedback is presented nicely, and the gamification aspect made the process of the learning interesting. In addition, the implementation of the dashboard motivated students to continue learning their second language.

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1. Introduction

The problem which will be discussed in this project is about the situation that every of the learning websites has to display the progress of the learner, meanwhile also making this displayed feedback useful and interesting experience for the user. It is assumed that the user will be motivated to continue his study by receiving positive, interesting, useful feedback.

This is a big challenge to do this, because there is no universal formula how to implement good gamification, which is still widely researched. What is gamification? Gamification is a concept of applying game mechanics and game design techniques to engage and motivate people to achieve their goals. Exactly this aspect will be explored in the scope of this projects, including visualization element to present all the implementations of the user's feedback nicely and readable for the user.

The project will take the Zeeguu website [1] and extend it with a Progress Dashboard which should at the minimum:

1. Provide feedback on the user activity. It should be easy for the user to visualize on a calendar the days in which user was active in the past, as well as the degrees of involvement in those days. For example, such visualization is the GitHub Activity Graph.

2. Provide feedback on the progress of the user. It should be easy for the user to visualize the progress of user's knowledge. The Zeeguu platform provides information about the number of words which the user is learning or has learned at any given time. By querying this data the dashboard should present trends in user learning.

Besides extending the existing web prototype, the project might involve extending the existing Zeeguu API with new endpoints which are focused on user progress.

The main nonfunctional requirements of this user progress dashboard are:

1. Usability. The way to test this will be a usability study in which a number of users will be asked to use the app.

2. Maintainability. To ensure the maintainability, a detailed design documentation will be provided which explains the design of the application.

3. Portability. The dashboard should be designed to be responsive. It should be possible to embed it in a WebView within a mobile application.

One critical aspect of the project will be usability. Multiple usability tests will be organized to optimize the interaction between the user and the progress dashboard. The project will start with a sprint in which a first prototype of the project will be completed. The second step in the project will be a usability study in which some number of participants will be asked to fill in the survey about the new Zeeguu dashboard. At the end of the study the feedback from the participants will be analyzed and future development directions for the dashboard will be prioritized.

1.1 Research question

The research question of this paper is: what is the impact of the dashboard on the behavior of the learners.

The research question will be possible to answer after all implementations and integrations of the new Zeeguu dashboard are done. Then some number of the users of the new Zeeguu dashboard will be asked to fill in the survey, where they will be asked about the new dashboard and be asked to provide a feedback on it.

The research question can be split into 3 sub questions.

By providing feedback to learners :

RQ1: How to show the feedback to the learner that it is understandable and readable?

RQ2: How to make it more interesting? Namely that it should be not boring.

RQ3: How to motivate the user?

2. Related Work

2.1 The Zeeguu platform

The Zeeguu platform [1] is an eco-system, which is created around an open API, which has the goal to enhance the learning process of new words of a foreign language. The primary version of the Zeeguu platform was developed by Simon Marti as a part of a bachelor's project at the University of Bern. Since the initiation time, the Zeeguu platform has expanded and several applications were designed, for example, Chrome extension, Android, iOS, Unity and smartwatch applications.

2.2 Chrome plugin

One of the tasks of Chrome plugin [9] is to allow the user to quickly add new words to the profile. In order to learn new words, user should click on the words and in such a way the translation of the word will emerge above it. Moreover, when the user clicks on the translation, the word is then saved in the account of the user. In a case where a translation is wrong, the user may adjust it.

2.3 Android application

Since Android is the most used operating system on smart phones, Android application [10] were created and included in the ecosystem of Zeeguu. Due to these applications, the user will spend more time on the learning of new foreign words. Furthermore, in this application new exercises were created in order to further enhance the learning process.

2.4 iOS application

The main aim of the iOS application [7] is the possibility to read news articles from various websites. The user may read any article in any language, which is being learned. In a situation if a word is unknown, the user may click on the word and the application would immediately display the translation. The new word may also be saved on the Zeeguu profile.

2.5 Smartwatch application

The smartwatch application [8] is included in the Zeeguu ecosystem, which is a research project created to accelerate and boost fun the vocabulary learning process. This procedure is based on three main aspects: only read the material which the learner enjoys, keep the learning words everywhere the person goes and practice with tailored exercises. Namely, users can read the any material provided in the application they like, click on the words they do not know and obtain direct translation in order to follow up with the reading and have a possibility to repeat them at a later time. The words will be kept in user accounts and can be accessed any time later.

2.6 Unity application Zeekoe

By using Unity engine learning games [11] were designed and implemented particularly for the Zeeguu API. In order for the users of this platform to have the option to study the words which they bookmarked.

3. Project Design

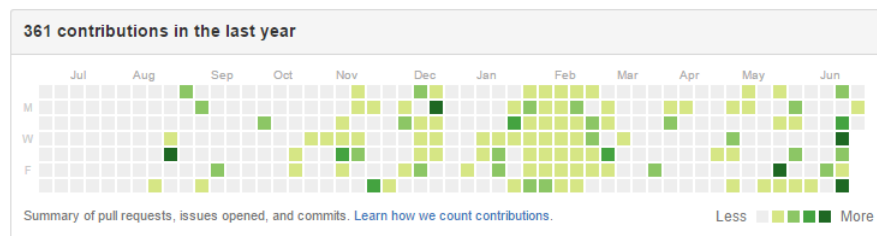
The first phase is to investigate other web platforms and see what good visualisation methods are they using. Moreover, in this phase it is needed to check if these visualisation methods can be motivational to the user to continue user's progress, as well if it is possible to make interesting experience for the user while using these visualisations.

3.1 Learner Activity Graph

First application experience which was checked was the GitHub [5]. It was checked, which visualisation methods GitHub dashboard is using and how GitHub dashboard visualisations motivate the user to be active and also give the user the feedback on its progress in the positive way.

It was noticed that activity graph of the GitHub is very effective in visualisation of the progress of the user for each day. Based on our trials and surveys of the users, it was also concluded that it can motivate the user to continue to work. It is because the user can see in the graph that user was working constantly every week. Moreover, suddenly for some weeks the user did not do anything. Then it shows for the user that user's activity spree has ended and the user will want to regain user's activity spree back by seeing that last weeks the user did not do anything. In addition, the other reason is that people sometimes do not notice that they stopped doing something, and it will be a good remainder to show them that they are not doing it as much as they think they are.

Figure 1: GitHub's activity graph



3.2 Learner Progress Graph

Other aspect which was investigated is to how to better show learned words the words learning to the user, which could also motivate the user and maybe even make a game of it. Based on these thoughts, the idea of using the line graph appeared. This line graph will show two lines: one will illustrate the amount of the learned words and other amount of the learning words. Correlation between these two lines will be showed, which will mean how good the user is learning the language. Based on how big is the gap between the lines, it will be possible to conclude the user's progress: the smaller the gap ,the better is user's progress. Moreover, it is possible to make gamification of it. Namely,the user has to improve the progress during the learning process in order to decrease the gap between these two lines. The user will be rewarded by achieving certain levels in the website, which will be created.

3.3 Learner Statistics

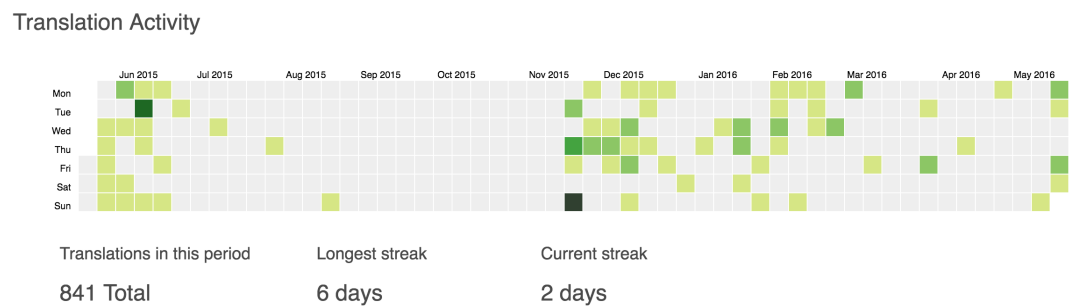
When it was concluded that current website statistics visualization is very bad, it was decided to implement the Vocabulary Statistics chart. Furthermore, it was decided to make these statistics more readable and more fun, than previous visualization, which before was a simple box of the text.

4. Project Implementation

4.1 Activity Graph

Inspired from the GitHub activity graph, the Translation Activity graph with some statistics was implemented (refer to Figure 2), which shows how many words the user has bookmarked each day. Depending on the amount of bookmarked words, the color of the cell changes (the more bookmarks, the darker the cell color).

Figure 2: Translation Activity Graph



4.2 Learner Statistics

Moreover, one of the tasks was to change the visualization of the statistics provided by the website (refer to Figure 3) into 2 graphs, instead of the clutch of text. The goal was to make it more viewable, readable, understandable, and more helpful.

That goal was achieved by developing one pie chart in order to show the following statistics:

1. Not encountered words
2. Known words
3. Already learned words
4. Still learning words

The second graph is a line graph, which shows how many bookmarks in total user has learned and how many still learning per each month.

Figure 3: Previous website statistics

Vocabulary

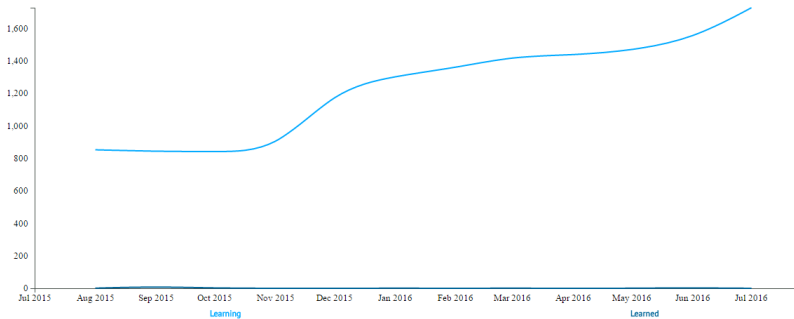
- Not Looked Up Words: 53
Words that were not looked up in a context where a word was bookmarked.
- Not Encountered Words: 9947
Words that have been not encountered yet in the list of 10'000 words used in day to day life.
- Percentage of Basic Vocabulary Known: 0.13% - 1.6%
Percentage of words you have learned looking at the top 3'000 words used in day to day life.
- Percentage of Extended Vocabulary Known: 0.04% - 0.53%
Percentage of words you have learned looking at the top 10'000 words used in day to day life.

Bookmarks

- Words Being Learned: 6
Words that have been looked up and are saved in your profile.
- Probably Known Words: 4
Words that you probably have learned according to your performance in Zeeguu .
- Words Already Learned: 0
Words that have been marked as Too Easy.
- Percentage of Probably Known Bookmarks: 0.0%
Percentage of bookmarks you probably have learned according to your performance in Zeeguu.

4.2.1 Learner Progress Graph

Figure 4: Learner Progress Graph



4.2.2 Vocabulary Statistics Chart

Figure 5: Vocabulary Statistics Chart Version 1

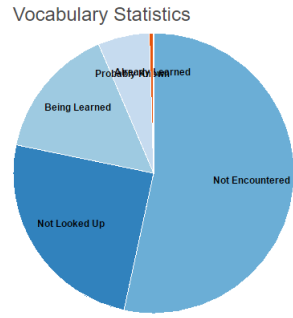
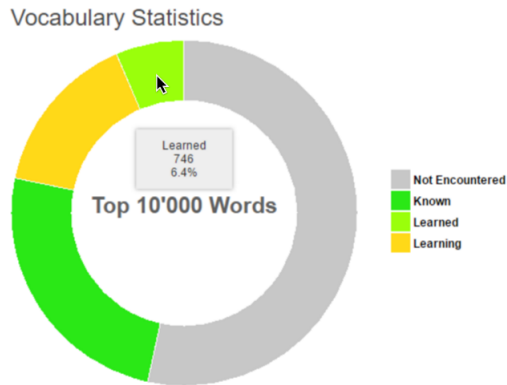


Figure 6: Vocabulary Statistics Chart Version 2



4.3 Back-End implementations

Moreover, for the Learner Progress Graph data calculations were implemented on the Zeeguu web server side. In addition, gamification aspects were implemented for Vocabulary Statistics Chart.

4.3.1 Gamification for Vocabulary Statistics Chart

Gamification aspect was introduced for the Vocabulary Statistics chart, which shows the general statistics about the relation of the user with the top 10.000 words of the basic vocabulary of the language.

It calculates and displays :

1. how many words the user has been mastering before using the app,
2. how many words the user has learned on the way,
3. how many words are in progress of learning.

The user has to unlock levels to get till 10,000 words. Each level compares user's progress to corresponding amount of words for the level, for example, level 1 is 500 words, level 2 is 1000 words and the similar pattern continues.

Figure 7: Gamification part for Vocabulary Statistics Chart



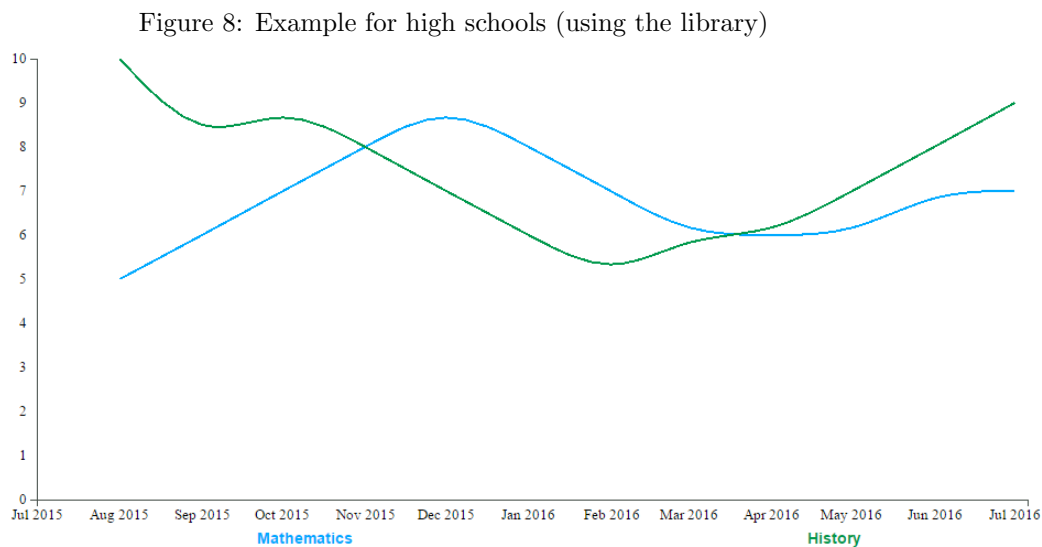
4.4 Standalone library - Zeeguu Learner Graph Module

A standalone library has been implemented, which is a JavaScript component which can be reused by other websites. It will help them to show to users their progress and the activity. This library already includes presetted graphs such as pie chart, line graph and activity graph.

4.4.1 The reason for creation of the standalone library?

One of the reasons for creation of the standalone library is that at the moment the best solution to make graphical visualizations was by using graphical library "d3js" [6]. This library is not very usable enough, because for implementing a simple graph 200 lines of code (without data generation) are needed to be written. It was not possible to find a library where it could be possible make the simple graph on the website by inputting just a data in one function. Therefore, it was decided that there should be better and faster way to display real time graphs, such as excel. Moreover, it would be beneficial to help other educational organizations to provide feedback to the learners about their study subjects, for example , high schools (average grade change per month per subject).

4.4.2 Example of using the library



This graph shows student's average final grade change per month per each subject.

4.4.3 Why it is important?

For example, Latvian high schools use only Nestor like system for grades and schedules. It is an idea to also provide more feedback to students, which might improve their grades. Based on that they can easily track their average grade per subject throughout the whole year and know on which subject what time they should concentrate.

4.4.4 Used code for the example

```
<!--module itself-->
<script type="text/javascript" src="zeeguu_learner_graph_module.js" charset="utf-8"></script>
<!--place where to append the graph on the page-->
<lgraph></lgraph>

<script>
    input_data = [{"name": "Mathematics", "amount": "5", "date": "Aug 2015"}, ... ,
                  {"name": "History", "amount": "10", "date": "Aug 2015"}, ... ]
    line_graph(input_data, "lgraph");
</script>
```

4.4.5 Available source code

A standalone library "Zeeguu Learner Graph Module" is available at given repository link:

https://github.com/MrAlexDeluxe/zeeguu_learner_graph_module

5. Results

As now after all implementations and integrations on the website are done. The survey was made to get feedback from the participants about the new Zeeguu dashboard. The survey was sent to 8 participants, and 3 of them answered and filled in the survey. This section presents the summary of the survey results. After summarizing the survey results, the research question will be answered at the conclusions section - what is the impact of the dashboard on the behavior of the learners. The survey itself can be viewed at Appendix A.2 section.

5.1 Summary of the survey results

5.1.1 Introduction section

In introduction section of the survey participants were asked a couple questions about the dashboard in order to see whether all participants understand the user interface of the dashboard. Most of the participants could give answers on these introduction questions, and therefore it can be concluded that majority of participants understood very well the user interface of the dashboard.

5.1.2 The Activity Graph section

All of the participants understood the Activity Graph , but only 2/3 of participants think that this graph will motivate them to progress in their language study. On the question about how useful is the Activity Graph, most of the participants found it to be very useful.

5.1.3 The Learner Progress Graph section

Most of the participants understood the Learner Progress graph and also found it very helpful. However, from one participant of the survey was received a complaint about The Learner Progress Graph, that it is not working as it is supposed to work.

5.1.4 The Vocabulary Statistics Graph section

All participants of the survey understood the Vocabulary Statistics chart and found it helpful, but each of them found it to be helpful in a different way. Namely, that one part found it motivational but other part found it more entertaining rather than motivational.

5.1.5 Comments, Suggestions, Recommendations from participants

Based on the feedback from the survey, it is very clear that user most popular suggestion is making the studying more competitive. One of the participants feedback was to make achievements, which notify the user of its progress and use the graphs as a complementary tool. Other participant suggestion is to implement score board of other learners , which could be viewed by other learners. Other suggestion is to implement most active users list.

5.2 Discussion of the results

The main research question of this paper is: what is the impact of the dashboard on the behaviour of the learners. Further, it was divided into three sub questions on which the conclusions can be drawn.

RQ1: First aim of this paper was to find out how to show the feedback to the learners of the language that it is understandable and readable. Majority of users were motivated to progress to their studies, and all the users were provided with visualizations which nicely showed their progress of their studies. The visualizations included such graphs as Vocabulary Statistics Graph, Learner Progress Graph and Activity Graph.

RQ2: Second, another goal was to find out how to make the learning of the language interesting. In order to examine that the level based gamification aspect for the Vocabulary Statistics Graph was implemented. Based on the survey results, the participants noted that this gamification aspect was interesting and helpful in learning the language.

RQ3: Third, another aim was to find out how to motivate the students. Results of the survey showed that for each of the user the motivation in learning the language was different. However, as the new implemented dashboard consists of multiple different graphs, all of them found a certain aspect that motivates them. Therefore, the goal was achieved in order to motivate the learners in studying the language.

Moreover, after considering the received feedback from the survey results, some more conclusions were made. Overall the new implemented Zeeguu dashboard passed all tests based on the survey. These tests were about showing learners progress, which should be readable and understandable, and at the same time making it motivational and interesting. Moreover, it is good to consider to implement the competitive aspect of studying for the website, as it was requested by the Zeeguu users. Moreover, this suggestion could be implemented in the future, because aspect of the competition always motivates other users to try harder to progress in their studies to became better than others.

6. Conclusion

In overall, as it was hoped the impact of the dashboard on the behavior of the learners is positive. In other words, the feedback to the learners was presented in an understandable and readable manner, and the gamification aspect made the process of learning interesting. In addition, the implementation of the dashboard motivated students to continue learning the language.

To sum up, the goal of this project was to help the language learners to progress in their studies, what was done. Of course, for some users it was more helpful than for others, but still new dashboard was helpful for everyone. Moreover, this project was not only designed to help language learners, but also to help any other kind of learners in their studies. Furthermore, it is possible to do, because a standalone library with dashboard visualizations was made, which could be easily re-used by other developers to help their website learners to progress in their studies.

7. Future work

Besides providing future support for my implementations including a standalone library. Future tasks are:

- Do deeper testing of the dashboard visualizations to make sure that for every user everything is working correctly, because one user mentioned that the Learner Progress Graph is not working for him.
- Still implement more customization aspects to the standalone library - Zeeguu Learner Graph Module. To make it easier for other developers to customize their graphs without changing the core code itself.
- Consider to implement the competitive aspect of studying for the Zeeguu website.

8. References

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- [11] <https://github.com/RUGSoftEng/Team-6>

A. Appendix

A.1 Notes

All current implementations are already used in Zeeguu language learning framework. Moreover, each finished iteration, which was checked and approved by the supervisor, is added to the working website to get the feedback from the users. All current implementations can be viewed at this link:
<https://zeeguu.uni.be.ch>

A.2 Survey

The image shows a survey interface with two sections. The first section, titled 'Section 1 of 6', is titled 'The New Zeeguu Dashboard'. It contains the following text: 'We have been busy implementing a new visualization dashboard for the Zeeguu website. Since you are one of the people who used the application in the past, we would be thankful if you could answer several questions about it. We appreciate very much your opinion, and suggestions, and we thank you for your time! Alexander Lukjanenkovs & Mircea Lungu University of Groningen.' The second section, titled 'Section 2 of 6', is titled 'A Little Bit About You'. It contains the following text: 'Before doing the survey itself, please answer some questions. First please login into your account, and study your own graphs.' Below this text are two questions: 'Can you estimate the number of days in which you have used zeeguu to translate texts ?' and 'Can you estimate the number of words you know in the target language ? *'. Each question has a 'Short answer text' input field.

Section 1 of 6

The New Zeeguu Dashboard

We have been busy implementing a new visualization dashboard for the Zeeguu website.

Since you are one of the people who used the application in the past, we would be thankful if you could answer several questions about it.

We appreciate very much your opinion, and suggestions, and we thank you for your time!

Alexander Lukjanenkovs &
Mircea Lungu
University of Groningen.

Section 2 of 6

A Little Bit About You

Before doing the survey itself, please answer some questions.
First please login into your account, and study your own graphs.

Can you estimate the number of days in which you have used zeeguu to translate texts ? *

Short answer text

Can you estimate the number of words you know in the target language ? *

Short answer text

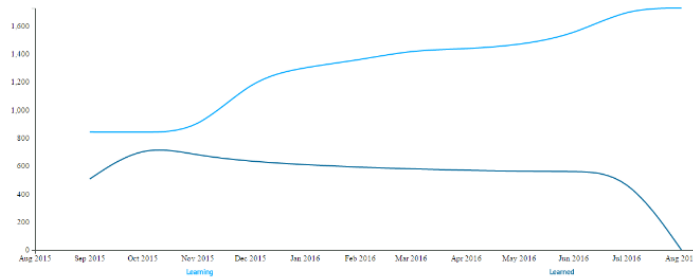
The Learner Progress Graph

The Learner Progress Graph shows the learning curve of the user for each month during the last year. It does that, by analyzing 2 criteria:

1. Words in progress - how many words the user is still trying to learn
2. Learned Words - how many words has the user already learned

The Learner Progress Graph can be found on the "My Account" tab on the website. Please go here to see your's: https://www.zeeгуu.unibe.ch/my_account
Alternatively, you can answer the following questions based on the example image.

The Learner Progress Graph example image.



Do you understand the Learner Progress graph? If no then please also explain why. *

Long answer text

Is the information presented in the Learner Progress graph useful? *

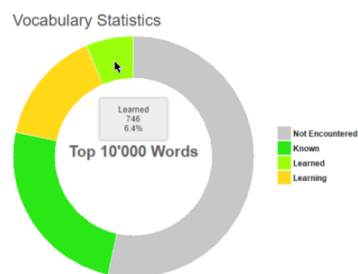
Long answer text

The Vocabulary Statistics Graph

The Vocabulary Statistics chart shows the general statistics about the relation of the user with the top 10.000 words of the basic vocabulary of the language. It calculates and displays how many words the user has been mastering before using the app, how many words the user has learned on the way, how many words are in progress of learning.

The Vocabulary Statistics chart can be found on the 'My Account' tab on the website. Please go here to see your's: https://www.zeeuu.unibe.ch/my_account Alternatively, you can answer the following questions based on the example image.

The Vocabulary Statistics chart example image.



Do you understand the Vocabulary Statistics chart? If no then please also explain why. *

Long answer text

Would the "Vocabulary Statistics chart" motivate you to study daily your new language? If no then please also explain why. *

Long answer text

How useful for you is this "Vocabulary Statistics chart"? *

1 2 3 4 5

Not at all Very helpful

Final Thoughts

Description (optional)

If you could add a new way of visualizing your knowledge or progress to the dashboard, which one would it be?

Short answer text

Which from all three graphs you don't like or doesn't help you? (please shortly explain why)

Long answer text

Comments, suggestions, recommendations ?

Long answer text