

# Vocabulary Mashup using Online Resources and Games for Vocabulary Training at School

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**Abstract:** This paper describes a general architecture and an implementation of a mobile system that helps teachers and pupils at school to learn vocabulary of a foreign language for specific lessons. The system can be setup in a flexible way that either vocabulary from an arbitrary course book or individual vocabulary sets can be specified as input by a teacher. Accordingly it can be adapted to the curriculum of a class. Furthermore the system keeps user information at an own server for security reasons and it does not cause any additional costs, e.g. for additional vocabulary sets. Online resources like synonym and antonym services, definition services or pronunciation services are integrated into the system for providing further learning activities. Finally game based elements shall make the learning activities more attractive to the students. The progress of the learning process will be provided for pupils and teachers. The system is targeted to facilitate the processes in a German school environment.

## 1 INTRODUCTION

Learning a non-native language at school is a task that almost all pupils have to deal with during their school education. In order to be proficient in a language, pupils have to master grammar and vocabulary of that specific language. Especially learning a vocabulary is a task that is often regarded as arduous and boring. However without knowing the vocabulary a language cannot be learnt. Tschirner (Tschirner 2003) points out that “Beginners need a lot of vocabulary and this as fast as possible, so that they can also learn by reading and listening on their own.”

In our paper we want to tackle this task in way that adolescents have a more playful approach to the vocabulary learning using one of their favourite devices, their smart phone (Anderson and Jiang 2018, p. 2), (Ebadi and Bashiri 2018), (Kukulska-Hulme 2018), (Godwin-Jones 2014) and (Qun 2014).

Looking at the use of smartphones we can see that beneath the use of social media, games play a significant role for this group (Anderson and Jiang 2018, p. 9). Especially (Kapp 2014) shows a positive impact of gamification on the learning outcome. (Papadakis 2018) looks in more detail into the choice

of games for learning situations. (Craud 2016) regards the effects of using gamification in the context of learning a foreign language in more detail.

Hence the idea is to combine these two trends in a smart phone app using different game based approaches for the learning process.

The general way of learning a vocabulary is a list of words with their translations. Often several aspects are not taken into account like the pronunciation or the fact that a word has different translations, i.e. synonyms that have the same meaning but are not used in the belonging text or lesson. On the other hand there are situations where it is beneficial to know not only the word but also the opposite, the antonym. Sometimes neither of this information is helpful. In this case a definition of the word is needed or even a picture.

Using a smart phone with internet connection can help to overcome these challenges, since there are websites that offer exactly these services (for free). Therefore there is not really a need to enter this information again. The pronunciation is mostly available not only as phonetic transcription also as a sound file spoken by a professional native speaker. Webpages for synonyms and antonyms are also

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available for many widely-used languages. The same applies for pictures.

Hence the integration of these services in an application has an additional benefit for the learner.

As another issue we want to address the question of vocabulary acquisition. Usually the vocabulary, a pupil has to learn, belongs to a text or a lesson. Concerning vocabulary sets belonging to a unit in a course book, resources may already be electronically available. Looking at a specific text, there may either be a printed list given to the learner or the student has to create this list on her own. Our approach aims at supporting different strategies for this task. Building a vocabulary set for the app using an authoring interface is one way. Another way is the acquisition of the vocabulary using photos or scans of a list and supporting the process using an OCR (optical character recognition, i.e. extracting text from an image or a photo) software for example.

In general the system must be easy to set up and to use for the pupils and for the teachers in order to be used daily in real school environment, where neither of them has the time to deal with complicated administration processes of the software.

While working with the system, the progress of the learning process shall be accessible to the learner and the teacher. The learner can clearly identify her weaknesses and the teacher has a good overview of the overall knowledge and progress of the class.

Finally data security is an important topic when talking about under aged children. Our concept aims at a system that can be exploited in a school, using the available infrastructure, so that no data has to leave this environment. This topic is especially interesting compared to commercial systems where users have to trust a third party.

The paper is structured as follows. We will first start with the related work discussion. Afterwards we will describe the general architecture of the application and the implementation for learning the English language for German schools. Finally we will conclude with a short summary and the discussion of our future work.

## 2 RELATED WORK

The idea to offer vocabulary training on smart phones or web pages is not new and there are several systems similar to our approach. (Godwin-Jones, R. 2018) gives a good overview on this topic. We target the specific question of supporting the vocabulary learning at school, where a certain lesson has to be learnt. The learning is often evaluated in form of a graded

vocabulary test. Hence it is important that the complete vocabulary of this unit is part of the learning material and that at least not an extensive list of other words would belong to this list.

### 2.1 Related Systems

(Makoe and Shandu 2018) describe the implementation of an Android app for learning English vocabulary. (Qun 2014) and (Bor-Tyng 2017) showed positive effects on the learning process for learning English vocabulary with their mobile applications.

Since we want to support German pupils we need a localized user interface. Other commercially available systems like 24/7tutor or AccelaStudy are also available only in English. In addition to the question and answer mode, they offer games as an alternative learning approach.

A comprehensive overview of existing systems can be found in (Bárcena et. al. 2015).

Therefore in the following we discuss two commercial systems available in German that are suited to our situation.

### 2.2 Commercial Systems in German Language

The Cornelsen Vocabulary Trainer (Cornelsen 2019) offers an App for Android and iOS for learning languages like English, French, Spanish, etc. The app offers vocabulary sets as in-app purchase belonging to lessons of their course books. The vocabulary can be customized for own purposes, but only on the individual smart phone. Helping with the pronunciation of words is integrated through playing sound files of these words. The user cannot write the words using the keyboard, she can only select words from a list. Furthermore user statistics and sample phrases are integrated into the system as well. Game based aspects are realized only on a single user basis. The user gets a score for each word she could translate correctly. The faster she is, the higher is the score.

Another application is Phase6 (Phase6 2019). The system is also strongly related to a German course book publisher and works together with their books. The app is available for several languages and offers vocabulary sets as in-app purchase belonging to units of their course books. Game based approaches are also part of the system, like "LiveMatch" where pupils can play against each other. Additionally the system provides the possibility to use it from different interfaces, like PC, tablet or smart phone. Further vocabulary can be added into the system and the state is synchronized between all accessing devices.

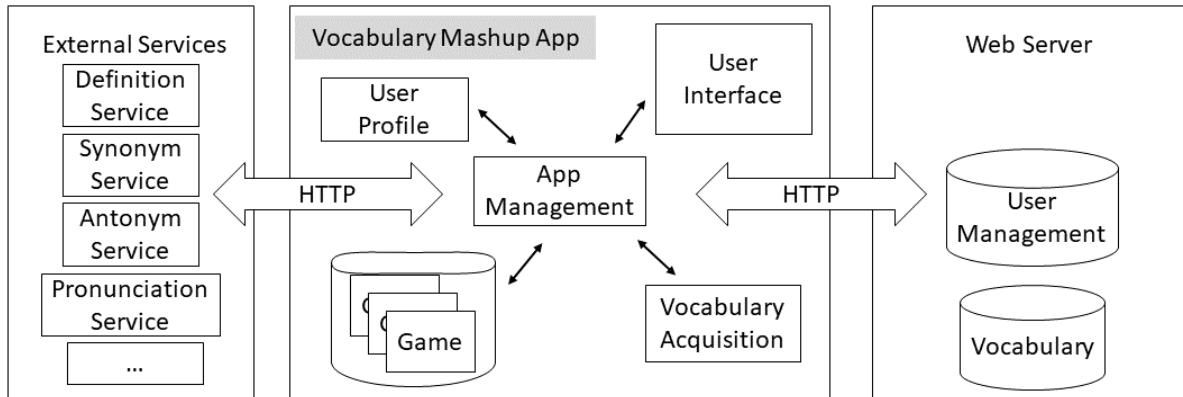


Figure 1: System architecture.

In a learning group mode, a teacher can supervise the learning advances of the group.

As a summary of those two systems, which are exemplars for a range of systems, we can see that users have to pay for the vocabulary they have already purchased with their books. Furthermore the systems do not provide the whole range of services that would be possible by using the already available resources on the web. Game based approaches are already integrated for an alternative and playful learning process. However adding additional games is only possible for the publisher. Finally and most significantly, the systems are strongly tied to the publishers. Switching from one publisher to another is neither supported nor intended.

### 2.3 Conclusion

As a consequence we will suggest an open platform that can integrate freely available online resources in order to build a system using different services that are useful for the learner, including game-based aspects.

The general idea of the usage is that teachers can easily integrate the system in their school lessons, ideally by taking a picture of the vocabulary that the class shall learn. Furthermore they shall have an overview of the progress of the class with that vocabulary.

The learners shall be able to select lesson and start learning, either individually in a traditional question and answer mode or using a game. Furthermore they shall be able to challenge their classmates using the offerings of the system.

Another aspect in a school context with younger children is the security of the data. Even if teenagers are rather unthoughtful about giving away information in their social media profiles over the internet, schools and parents are sensible when it

comes to storing personal data. This fact urges for a solution, where the application and the personal data is under full control of the school.

## 3 TECHNICAL CONCEPT

The idea of our application is to support the learning of the vocabulary for a foreign language. As we mentioned in the beginning, we want to create a flexible architecture that offers several services. The services range from the vocabulary acquisition i.e. the authoring over the integration of pronunciation services, synonym/antonym services or word definition services until to the game-based approach that shall offer a playful touch to the learning task.

The general architecture is shown in figure 1. The architecture illustrates that the app communicates with external services using the HTTP-protocol. An interface should be defined in a way that changes in the services API or switching from one service to another will not affect the core implementation of the app for providing a flexible integration of different services supporting different languages.

```

interface ISynonym {
    List<String> getStringList
        (String word);
}
  
```

The code shows a basic example of an AIDL specification of the interface for the synonym service. Other services would look similar. The pronunciation service however returns an URI for the media file.

Especially minor changes in the APIs of the connected services have already appeared during the realization of our prototype. Therefore a separation of the two sides using an interface helps keeping the implementation modular and flexible.

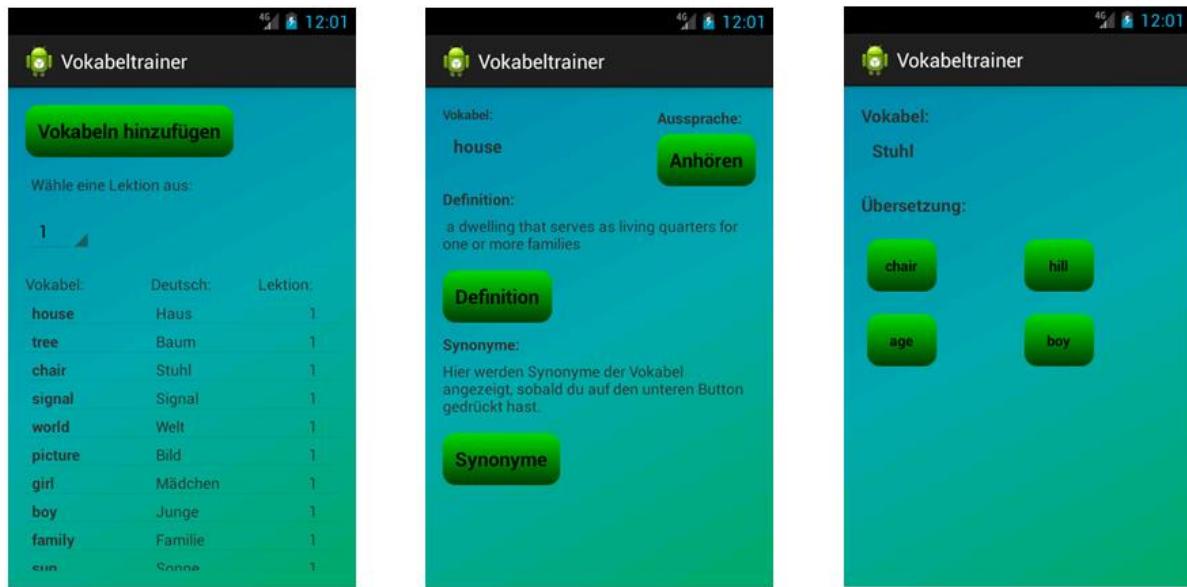


Figure 2: User interface for vocabulary input (left), display of synonym and pronunciation (middle) and query (right).

User data and vocabulary resources are located on a web server belonging to the system. User data are needed for personal achievements like high scores or group games. The vocabulary can easily be updated and changed for a whole class when it is stored on a server instead of the individual device. Furthermore an additional authoring interface can be realized for more powerful input devices.

The integrated games use the vocabulary resources and offer playful approaches on top of the traditional question-and-answer task. The user profile keeps local user information and is also updated with information from the User Management.

Finally the vocabulary acquisition can be realized in different ways. On the one hand a traditional authoring interface can be provided with input fields for the word and its translation. Maybe the publishers of the course book may offer an electronic export service in a way that the vocabulary can be gathered automatically. Finally a service where the user will take a photograph or scan a side with words and processing it with OCR may be an additional way to make the acquisition of the vocabulary more comfortable.

## 4 IMPLEMENTATION

The implementation is divided into the server and the client part, the app.

An overview of technical implementation aspects of this type of systems is given in (Godwin-Jones 2011).

### 4.1 Server Side Implementation

Our implementation is based on an Ubuntu Server with a MySQL database. The database is used to store the vocabulary, which is associated with an ID specifying the set, e.g. the lesson.

The user data is the general information about the user as well as the score. Furthermore the information about group games is stored, in our case the duels. More specifically we store the information about the duel type, requested duels, accepted duels and finished duels. The duel type refers to either an identifier belonging to a set of words that has to be translated or to one of the games that exists on the smart phone.

The programming language PHP is used on the server side. The queries are SQL statements executed from a PHP script. The results are communicated to the client in the JSON format.

### 4.2 Client Side Implementation

The client sides is implemented as a native Android app. Android has been used as a first target platform since it has a market share of more than 75% by December 2018 (Statcounter 2019). Furthermore we support learning the languages English and also Spanish for a German user in our first version.

The user interface is an Android activity that serves as an entry point for the app.

The vocabulary acquisition is realized in our first version as a layout with two input fields (see figure 2).

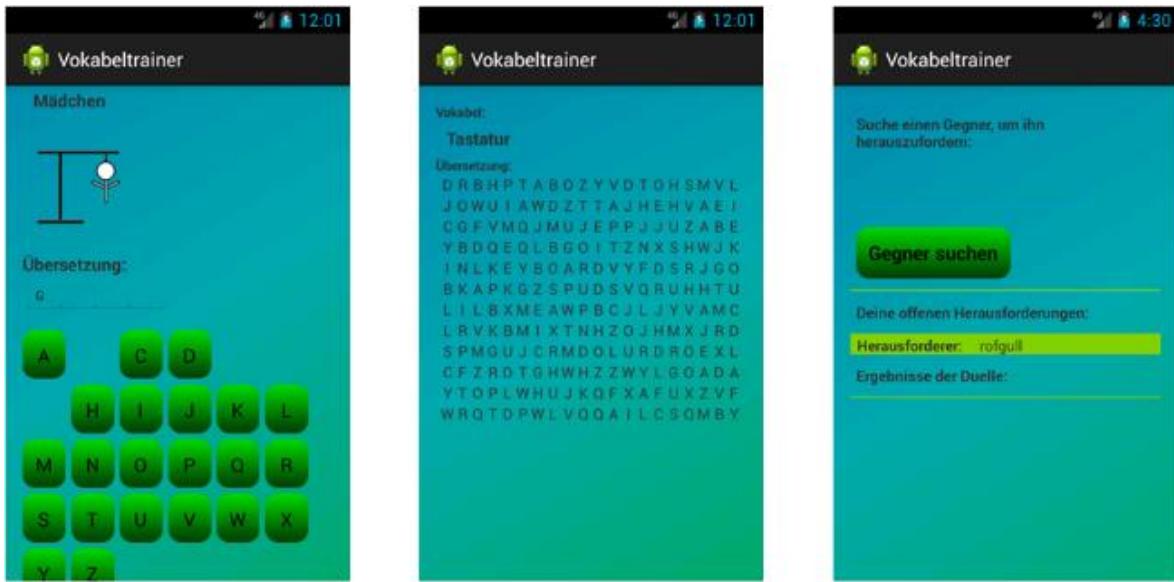


Figure 3: Vocabulary games: Hangman (right), word search puzzle (middle) and duel request (right).

More sophisticated possibilities are planned for the future. After entering the vocabulary, the words can be queried in both ways, foreign language to mother tongue and vice versa. Figure 2 shows on the right hand side a several choices for the translation of a German word. The user has to push on the button with the correct answer. Another possibility not shown in the picture is a text input where the user has to use the soft keyboard of the smart phone to enter the word. At the beginning of the vocabulary training, the user can configure how many times she will be asked for each word. The presentation of the words is random.

The screen in the middle of figure 2 shows three additional buttons. One button will display the definition, the other button will show synonyms and the third button will launch the media player that pronounces the word. These features are realized using external services that are freely available in the internet.

The definition service is realized using “Dictservice” (Dictservice 2019). The service is available only for a limited amount of requests without further agreements, which was sufficient for our prototype. Requests can be submitted in the easiest way through an HTTP GET request and encode the word in a URI. The following request will look up the definition of the word “house”.

```
http://services.aonaware.com/DictService/DictService.asmx/Define?word=house
```

Afterwards the response has to be parsed in order to extract the definition and to be rendered in the user interface.

The synonym service is realized in a similar way. “Datamuse” (Datamuse 2019) offers the possibility to send requests to a server asking for synonyms. The free version is limited to 100,000 requests per day. Requests can also be submitted as an HTTP GET request with the word encoded in the URI. The following request will look for synonyms of the word “house”.

```
http://api.datamuse.com/words?rel_sy  
n=house
```

The response is encoded in the JSON format and has to be processed in the client in the same way as it has been done for the definition service.

The last external service that is integrated into the app is the pronunciation service. In this case we have used Miriam-Webster (Miriam-Webster 2019). Their Merriam-Webster dictionary API is free for non-commercial use under 1000 queries per day. We use the reference to the sound file to invoke the media player.

The playful approach for the vocabulary learning app is realized as a number of games that are integrated in the app. The app is designed in a modular way so that further games can be added in the future. Right now we have implemented the games “Hangman”, a word search puzzle and the duel (see figure 3). However the duel is more a multiplayer

mode for all of the games and the general vocabulary query as a game of its own.

Hangman is a game where the user has several attempts to find the correct translation for a word. In our case she has five possibilities. The user gets feedback on the progress of the game through the stepwise creation of the final picture. Different characters are offered underneath the word and the learner has to push the button with the correct character starting with the first letter.

The word search puzzle is matrix of characters, where a word from a unit is hidden either horizontally or vertically. In this case a learner has to find the word and swipe with her finger over the word.

The duel mode is way to challenge another user in order to see who is more proficient on the vocabulary. As the word duel says, it is a two player game. The traditional vocabulary query can be selected for challenging another learner. The games can be selected as well. Each user will be asked the same vocabulary. The one with the highest number of correct answers will win.

The learner can access her general score and the results of the duels at any time.

## 5 CONCLUSIONS AND FUTURE WORK

First we will give a short summary of our achievements. Afterwards we will talk about the open questions and improvements of our concept.

### 5.1 Summary

In this paper we have presented an app for learning vocabulary. The app is targeted at young learners in a school context. The general idea is that learners can use their smart phone in any situation to rehearse their vocabulary.

Additionally we target the integration and import of vocabulary for specific lessons or texts. Therefore the app is flexibly usable since it has neither additional costs for the vocabulary nor is it tied to a specific publisher.

On top of the basic vocabulary query we have implemented a couple of games in order to make the process of vocabulary learning more entertaining. Especially the duel mode offers the possibility to not only work alone on the learning but also to compare their proficiency with other learners.

Freely available web resources have been integrated into the system as well. Therefore not only

the vocabulary is displayed but also definitions, synonyms, antonyms and the pronunciation without having to enter all this information manually.

Compared to the commercial systems our approach has the functional advantage that services like finding synonyms, antonyms or word definitions are included. Since we use a modular approach further services or games can be integrated easily, as we will suggest in the following section. Furthermore teachers can select books of different publishers or they can even use vocabulary for special purposes like newspaper articles or classic literature. Additional games can be implemented as well. Finally data security aspects can be tackled in the school environment in a way that no information is transferred to third parties.

### 5.2 Discussion and Future Work

In the future we have to deal with several questions. First of all we have to evaluate if our concept and the belonging system are really useful in the school context. We have only just finished the implementation of the system and were not yet able to conduct a user study. Our research hypothesis will be:

- (A) Students have more pleasure in the vocabulary learning
- (B) Students perform better in regard to memorizing vocabulary compared to the “old-fashioned” approach using a book.

Even though there are already analyses of applications using gamification aspects, as we have stated in the introduction, we have to see if this is true for our implementation as well. Therefore a careful evaluation with a group of pupils is needed to see if our hypotheses are correct.

Primarily the integration of such a tool in school lessons in a way that it fits the didactic approach of the teacher is crucial (cp. Papadakis, Kalogiannakis 2017) in order to gain the acceptance of the educators. Therefore our next step is a discussion with teachers for foreign languages.

Afterwards a comparative user study with pupils has to be conducted. The prerequisite for our hypothesis (A) is the evaluation of the acceptance of our system. Beneath the general user interaction with our app, the integrated web services must prove to be reliable. They must produce the correct results for the requests as well. When it comes to dropouts, mistakes or ambiguous results the reaction of the learner has to be evaluated carefully in order to make sure that the system behaviour does not produce negative effects on the learning process. Then we can start comparing

the effectiveness of our system compared to other methods.

A future research question would also be the proficiency of the learner with the vocabulary if possibilities like synonyms, antonyms, definitions etc. are integrated easily accessible into a learning environment. It is imaginable that users acquires a deeper understanding of the words and can use these word more appropriate.

From a technical perspective there are several additional features we want to realize. Some of the commercial systems show photos instead of words and the user has to find the translation. An integration of such a service is possible in the same way as we have integrated the other web services. For example Unsplash (Unsplash 2019) offers a photo search service under similar conditions.

While listening to a native speaker is one point, speaking a word correctly is a further challenge. Voice recognition would therefore be another option to exploit, e.g. using the service from the Duolingo (Duolingo 2019).

An important point in relation to the web integrated services in general is the free usage of these services. If the user had to pay for the services it would lead to the question if the system will remain affordable. Especially, an important advantage of our implementation would be challenged. At this point issues about framework agreements would arise, which should be dealt with. However these are topics we would have to discuss with legal experts.

Additionally versions for different platforms would be meaningful for not excluding groups of learners. A version for iOS would therefore be a next step and an implementation as web based application so that a learner is more flexible in the choice of her accessing device. A careful evaluation of cross platform development tools like "Xamarin" or web based frameworks like "React Native" must be carried out as an alternative development basis. Consequently a synchronization between the devices would be another challenge.

Finally security aspects have to be evaluated carefully. The communication as well as the user specific data has to be secured carefully. Especially there has to be a policy about the data access that is strictly integrated into the system, see (European Union 2016).

On the long run we plan to publish the system as an open source project. Therefore localization is another aspect that has to be looked into more detail in order to adapt the user interface for learners from other countries to their language.

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