



Research Article

ANALYZING A LEARNER DEVELOPED CHATBOT AND ITS EFFICACY IN LEARNING BASIC GERMAN GRAMMAR – AN EXPERIMENTAL STUDY

SubhasriVijayakumar¹ and Joseph Sathiaraj²

¹German, School of Social Sciences and Languages, VIT Chennai

²School of Social Sciences and Languages, VIT Chennai

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ABSTRACT

The advent of Information and Communications Technology (ICT) in education provides room for innovation in pedagogical approaches and one of the tools gaining popularity in recent times is Chatbots that facilitate Human-Computer Interaction. This paper exemplifies how a Chatbot was developed by the learners themselves to learn basic German grammar. An experimental study was conducted among the undergraduate learners of engineering learning Basic German as part of their curriculum and this paper reports the initial observations and feedbacks from the students and analyzes quantitatively the efficacy of the Chatbot to learn foreign languages.

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INTRODUCTION

Learners of foreign languages all over the world face the challenge of exposure to the target language outside the classroom and the teachers' biggest challenge would be to facilitate this exposure. With the advent of technology, there is voluminous data available in the internet in all forms through websites, YouTube and MOOC courses but guiding the learners to the right material and motivating them to use them outside the classroom remains a laborious task. Every day there is probably a new website launched or a new video uploaded and Apps are also being developed to learn languages. Through the blended learning approach that supplements face-to-face teaching with technology-based instructions, teachers aim to extend foreign language learning beyond the walls of the classroom.

At the tertiary level, especially in engineering domain, instruction of core technical skills is of primary importance and language instruction is seen only as an auxiliary skill. Blended learning, project based learning, task based learning etc. are used to integrate practical exposure to the theory taught in class but its usage in foreign language classrooms are very minimal. Especially in Indian scenario, where every classroom is characterized by the large number of students who are multilingual and multicultural in their makeup, the inadequate infrastructural facilities, exam centric approach to

teaching, short duration of courses etc. still make foreign language teaching teacher-centric and there is a long way to go to implement learner-centric models in foreign language instruction.

In the Indian private technical university where this experimental study was conducted, foreign languages are taught to the undergraduate engineering students and students of all branches of engineering choose one foreign language from a basket of languages like German/French/Spanish/Chinese and Japanese. These foreign language courses are for the beginners and attempt to teach the very basics of the language to them. The large size of 70-80 students in a classroom, fixed furniture, the duration of 50 minutes per class and the fact that these students learn a foreign language after having learned three or four other Indian languages and after learning English compounds the complexity of the teaching-learning process of foreign languages. The students are shy and feel embarrassed to talk in the target language amidst their peers due to the fear of making mistakes or sounding wrong due to incorrect pronunciation. Giving opportunity to 70-80 students to speak/read out loud in the class and playing audios for enhancing listening skills become a cumbersome task to the teacher and the exam centric approach followed lays emphasis on extensive use of textbooks in class, which at times again do not provide adequate exercises for practicing vocabulary or grammar in the target language. All these puts the language teachers in a sensitive position and the burden of conducting an effective foreign language class weighs heavily on the shoulders of the teachers alone. It is up to the creativity

***Corresponding author: SubhasriVijayakumar**

German, School of Social Sciences and Languages, VIT Chennai

and responsibility of the teacher to make the learning process vigorous, efficient and meaningful.

At the university where this study was conducted, different approaches to learning are implemented and to integrate practical, hands-on learning to the theory concepts dealt in engineering subjects, Project Based Learning (PBL) is predominantly used as an effective method to assess learning outcomes. With projects in engineering subjects being technical and language related projects emphasizing on enhancing a specific language skill, at times in a semester students do 5-6 mini projects as a team for their academic internals grading.

The non-availability of suitable material for learning the basics in German and the desire to create something new for the learners by the learners themselves to learn the basics of German and incorporating it as part of the PBL component facilitated in the ideation of this experimental study which is detailed in the following sections.

Why a Chatbot?

Learners of 21st century are technology savvy and digital natives who spend a lot of time on messaging portals and laptops and mobile phones have become central to their existence. Human to human interaction that too face-to-face interaction has dwindled and interactions among people are now largely mediated by the machines. Human-Machine Interaction (HMI) has also amplified in recent years with Human-Computer Interaction (HCI), Human-Robot Interaction (HRI) and Artificial Intelligence (AI) gaining prominence.

A new trending concept in this field would be the 'Chatbots', a promising technique for human-computer interaction. Chatbot is a computer program designed and developed for a specific purpose to simulate a human conversation. The general function of a Chatbot is to mimic intelligent conversation. Just like language being used by people for human interaction, the same language can also be used to facilitate Human-Computer Interaction (HCI). HCI is best facilitated when users express their interest, wishes, or queries directly and naturally, by speaking, typing, and pointing which is the driving force behind the development of Chatbots. As Shawar (2011) defines it "A Chatbot is a conversational software agent, which interacts with users using natural language".

Also known as 'Chatterbot', 'talkbot' or 'Bot' a Chatbot is a "computer program which conducts a conversation via auditory or textual methods" (Komawar Om et al, 2015). We all know about the famous speech based search engines like Siri and Cortana, which use voice queries to answer questions, perform phone actions, schedule events and reminders etc. The other popular platforms for Chatbots which can be accessed through Apps or Websites are FB Messenger, Skype and We Chat etc.

The Chatbot architecture combines a language model and computational algorithms to reproduce chatting scenarios between the computer and the humans. Conversation techniques between a human and a computer can be either (a) chatting by typing text or (b) speech dialogue using the voice. In a speech dialogue using the voice, first the speech is converted to text and then this natural language text is processed by the Chatbots' algorithms to return a response that can be a text or speech. This process is as represented in Figure 1 below.

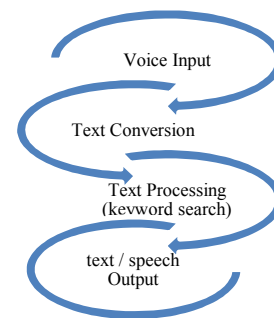


Figure 1 Chatbot Process of speech dialogue using voice

LITERATURE REVIEW OF EARLIER CHATBOTS

The design and development of Chatbots date back to 1960's when it was first designed for fun, using simple keyword matching techniques to find a match for a user input. Weizenbaum created ELIZA in the 1960's as a program operating within the MAC time-sharing system at MIT. The input sentences in natural language were analyzed on the basis of 'decomposition rules' and responses were then generated using 'reassembly rules' (Weizenbaum 1966). Joseph Weizenbaum's ELIZA in 1966 emulated a psychotherapist and many believed its potential to positively influence people suffering from psychological issues. From then on, many Chatbots have been designed and developed for various purposes in different fields.

Richard Wallace developed ALICE (Artificial Linguistic Internet Computer Entity) in 1995 and Rollo Carpenter created "Jabberwacky" in 1997 to mimic human interactions and carry out conversations with the users.

Be it to process requests like booking tickets or ordering food or getting a service, chat automation has invaded the business sector due to its 'multiplicative effect on revenue generation' and being available 24/7 at service. Now the advent of Chatbots is seen in various fields like Medical education, health care, business sector, gaming, education and E-learning also.

To automate concierge, Chappie – a semi-automatic intelligent Chatbot was developed to be used as a routing agent to classify user requirements based on the services provided by the business and transferring it to the agent expert in the field (Behera2016).

Rosmalen et al in 2012 introduced a Chatbot to the existing serious game environment called EMERGO to enhance students' interaction with the training program in a medical treatment environment (Rosmalen et al, 2012).

Fryer and Carpenter saw Chatbots as an emerging language learning tool and using two well-known bots in their classroom to practice a language and based on the feedback given by 211 English as native language speakers who used these two bots, they believed that language teachers could make use of this technology in their foreign language classroom for practicing the target language (Fryer&Carpenter, 2006)

Jia and Chen in 2009 designed an 'interactive web-based human-computer dialogue system with natural language for English instruction'. Free chatting and chatting on a given topic along with the application of the CSIEC system in English Language Teaching (ELT) motivated the learners to use English and enhance their learning process. They also emphasized on the pedagogical implications these chatting

brought with it like improvement in listening skills, mastering practical expressions and the overall interest in learning English (Jia and Chen, 2009).

Bhargava.V and Maheshwari.N in 2009 developed an Automatic Speech Recognition Model used in an E-learning system for English language basic tutorial. Designed as a E-Learning system for children with disability, the Chatbot had a friendly and rich GUI (Graphical User Interface), a store of different queries related to English language and simple answers to them and a facility to repeat the answers, give examples if required and also talk on general topics of interest like directions and about the institute in which it was used (Bhargava and Maheshwari, 2009).

Chatbots have also been developed to improve pronunciation in foreign languages (Okumoto, 2004; Ming and Bai, 2011) and to enhance learner motivation and learning effectiveness.

Apart from these three Chatbots developed to augment foreign language learning there are also two other Chatbots found for German language learning in the internet. One is the Duolingo Bots and the other is the Mondly's voice Chatbot. Both the Chatbots are available in different languages and make conversation in any language easy sans the anxiety and fear of making mistakes while talking in a new tongue.

Although it's an undeniable fact that Chatbots are revolutionizing the way languages are learned and practiced, many of these Chatbots are complex and to hold and understand a conversation with them in a foreign language requires the learners to be of intermediary or advanced level and hence becomes again a challenge to the beginner level learners of the language.

Background to develop a Chatbot for the learners and by the learners

One of the major difficulties faced by the learners of basic German was remembering the articles of the nouns, their plural forms and the conjugation of the verbs. In English all these grammatical concepts are fairly simpler and German cannot be compared with English to learn these concepts. Learners always shared this difficulty of learning German grammar in class and collectively many possibilities accessible through Internet and mobile phones had been discussed right from the online verb conjugator to the various Apps and websites available but each one had its own constraint in one form or the other. For example, the online conjugator available in the internet conjugated the verb given by the user in all the tenses and moods but sample sentences were not available. Meanings of the verbs in English were also not found and verbs had to be typed in German only.

A classroom discussion one day in the light of this led to a discussion on can we ourselves develop an App for

making German easy for the beginners and three students of computer science engineering then pursuing an Artificial Intelligence course came up with the idea of developing a Chatbot for learning basic German grammar. Further brainstorming sessions helped in fine tuning the idea and it was decided to take up the development of a Chatbot as a project that was a part of the Project Based Learning (PBL) component too.

The three students who volunteered with this idea took the responsibility of designing and developing the Chatbot from the technical end and two more students along with the German faculty took to collecting and creating a corpus of nouns, their plural forms and verbs in German with their meanings in English.

Design of the Chatbot – "ChatbotDeutsch"

The German Chatbot "ChatbotDeutsch" was designed using JavaScript, html5, CSS, meSpeak.js (a Text-To-Speech library based on eSpeak), bot.js (a custom configurable part of Chatbot in JavaScript) and a terminalib.js (a terminal like interface element).

The Chatbot was designed as a simple text based Chatbot that gave a text response in return after processing a text search. It was a web based Chatbot that could be accessed through the net, but in this experimental study it was launched in the Intranet, thus accessible within the university campus only. Figure 2 below illustrates the process 'ChatbotDeutsch' followed to return outputs.

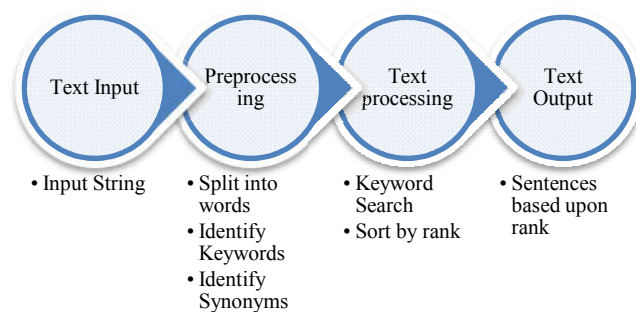


Figure 2 The Process of the German Chatbot – 'ChatbotDeutsch'

Step 1: When an input string was given to the system, it was parsed and converted from canonical form to make it easier for the system to break it down. It was then split into words using regular expressions. The words were then searched in the synonyms list to find matching words as shown in figure 3.

```

var indexSynons = {
  "be": ["from", "is", "are", "was"],
  "belief": ["feel", "think", "believe", "wish"],
  "cannot": ["can't"],
  "desire": ["want", "need"],
  "everyone": ["everybody", "nobody", "noone"],
  "family": ["mother", "mom", "father", "dad", "sister", "brother", "wife", "children", "child"],
  "happy": ["elated", "glad", "better"],
  "sad": ["unhappy", "depressed", "sick"]
};
  
```

Figure 3 Synonym List for Input Strings

Step 2: The Verbs that are not required in the given input string were also removed based on the grouping variables created as shown in Figure 4 below.

```
var inderPres = [
  "dont", "don't",
  "cant", "can't",
  "wont", "won't",
  "recollect", "remember",
  "recall", "remember",
  "dreamt", "dreamed",
  "dreams", "dream",
  "maybe", "perhaps",
  "certainly", "yes",
  "machine", "computer",
  "machines", "computer",
  "computers", "computer",
  "were", "was",
  "you're", "you are",
  "i'm", "i am",
  "same", "alike",
  "identical", "alike",
  "equivalent", "alike"
];

var inderPosts = [
  "am", "are",
  "your", "my",
  "me", "you",
  "myself", "yourself",
  "yourself", "myself",
  "i", "you",
  "you", "I",
  "my", "your",
  "i'm", "you are"
];
```

Figure 4 Variable grouping for verb search in the input strings

Step 3: After step 1 and step 2 were performed, the input string was reduced to only ‘keywords’ that helped in identifying the core meaning of the input string. All these keywords were sorted based upon their ranks that were already given in the Data.js file as shown below in figure 5.

```
/*
  Array of
  [<key>, <rank>, [
    [<decomp>, [
      <reasmb>,
      <reasmb>,
      <reasmb>
    ]],
    [<decomp>, [
      <reasmb>,
      <reasmb>,
      <reasmb>
    ]]]
  ]]
```

Figure 5 Array of ranks created for keywords

- If there were multiple keywords identified in the string, they were sorted based upon their ranks.
- The keyword with the highest rank was then resolved.
- Figure 6 below exemplifies the structure of the array with rank 0 with an example.

```
["kuli", 0, [
  ["singular of kuli", [
    "der Kuli"
  ]],
  ["plural of kuli", [
    "die Kulis"
  ]],
  ["sentences on kuli", [
    "1. Ich habe einen Kuli", "2. Der Kuli ist neu", "3. Ist das ein Kuli", "4. Wo ist der Kuli"
  ]],
  ["kuli", [
    "Meaning - Pen", "Singular - der Kuli", "Plural - die Kulis",
    "1. Ich habe einen Kuli",
    "2. Der Kuli ist neu",
    "3. Ist das ein Kuli",
    "4. Wo ist der Kuli"
  ]],
  []
]]
```

Figure 6 Array for the word ‘Kuli’ with rank 0 (highest priority)

Example 1: If the input string was “Write some sentences on Kuli” , then the Chatbot performed the following steps to return the output.

Step 1: The string is broken down as { Write’, ’some ’, ’sentences ’, ’on ’, ’kuli’}

Step 2: Synonyms and verbs are removed. Now we have {’sentences’, ’kuli’}

Step 3: Since ‘kuli’ is of higher rank, the system will look for the array with the key named ‘kuli’, as illustrated in figure 6. Once it is retrieved, it will search for the keyword ‘sentences’ and return back the following data as given in figure 7:

```
IPS: Guten Tag! Wie kann ich Ihnen helfen?
YOU: write some sentences on kuli
IPS: 1. Ich habe einen Kuli.
> 2. Der Kuli ist neu.
> 3. Ist das ein Kuli?
> 4. Wo ist der Kuli?
```

Figure 7 Sample text output in the Chatbot

Example 2: If the input string was “What is the plural of Book”, then the Chatbot performed the following steps to return the output.

Step 1: The string is broken down as { ’What’, ’is ’, ’the ’, plural ’, ’of’, ’book’}

Step 2: Synonyms and verbs are removed. Now we have {’plural’, ’book’}

Step 3: Since ‘Book’ is of higher rank, the system will look for the array with the key named Book. Once it is retrieved, it will search for the keyword plural and return back the following data: ‘Das Buch – Die Bücher’.

Example 3: If the input string was “can you conjugate kommen”, then after performing step 1 and 2 the keyword ‘kommen’ and ‘conjugate’ would remain and in step 3 the Chatbot would return the conjugation table in present tense along with the English meaning of the verb, one affirmative sentence and one interrogative sentence.

Example 4: If the input string was “what is auto”, then after performing steps 1 to 3, the Chatbot would return the results as illustrated in figure 8 below:

```
IPS: Guten Tag! Wie kann ich Ihnen helfen?
YOU: What is Auto?
IPS: Meaning - Car.
Singular - das Auto.
Plural - die Autos.
> 1. Das Auto ist teuer.
> 2. Wie viel kostet das Auto?
> 3. Ist das dein Auto?
YOU: tschuss
IPS: Tschuss. Schoenen Tag noch.

**** END OF SESSION. START TYPING TO BEGIN A NEW ONE. ****
```

Figure 8 Sample chat screen and text output

As an experimental study the Chatbot was designed with a corpus of all the nouns, its singular and plural forms and the

verbs with their present tense conjugation and sample affirmative and interrogative sentences as given in an A1 level German text book.

At this experimental stage 'ChatbotDeutsch' processed text inputs based mainly on keywords like 'singular', 'plural', 'sentences' and 'conjugate' to return the appropriate and corresponding outputs.

The study

The "ChatbotDeutsch" so designed and developed by the learners was launched in the intranet accessible within the campus. Thirty five first year students of undergraduate engineering enrolled in the Basic German course during the fall semester of 2017 volunteered to take part in this study.

These thirty five students were given a pre-test that tested them on verb conjugations, article of nouns, plurals and basic sentence construction. Their answers were evaluated and tabulated. After the pre-test, these thirty five students were introduced to 'ChatbotDeutsch' and were asked to use the Chatbot for fifteen days from the start of the study. After fifteen days, the students were given a post-test in the same syllabus as in the pre-test. After the post-test, the thirty five students were asked to fill up a feedback form which quantitatively assessed their usage of 'ChatbotDeutsch' during the experimental period, the usefulness of the Chatbot to learn German grammar and the user-friendliness of the Chatbot. To qualitatively assess their learning experience with 'ChatbotDeutsch' they were also asked to write three things they liked about 'ChatbotDeutsch' and three areas they would like to improve in 'ChatbotDeutsch'.

The following section presents the findings of this experimental study with 'ChatbotDeutsch'.

Findings

'ChatbotDeutsch' designed and developed by the students as part of their PBL project was tried and tested with thirty five learners of the Basic German course and Table 1 below shows the pre-test and post-test scores of these students who were a part of this experimental study.

Table 1 Pre-test and Post-test scores

Type of test	Mean	N	t value	Sig. (2-tailed)
Pre-test	25.07	35	13.6*	.000
Post-test	34.11	35		

*t value > 0.000 implies that the major difference is significant at 0.000 levels or at 99% confidence level.

The findings of the feedback given by the thirty five students are presented in Table 2 below.

Table 2 Feedback from the students on using

How frequently did you use 'ChatbotDeutsch'?		
daily	sometimes	rarely
24	10	1
How useful was 'ChatbotDeutsch' for your learning German grammar?		
very useful	useful	not useful
27	8	0
How user-friendly is 'ChatbotDeutsch' for learning German?		
very user-friendly	user-friendly	not user-friendly
26	6	3

'ChatbotDeutsch'

DISCUSSION

It is evident from table 1 above that there is a marked improvement in the scores of the students from the significant mean difference at 99% confidence interval and from this we can deduce that the intervention has proved to be useful and effective to learn German grammar.

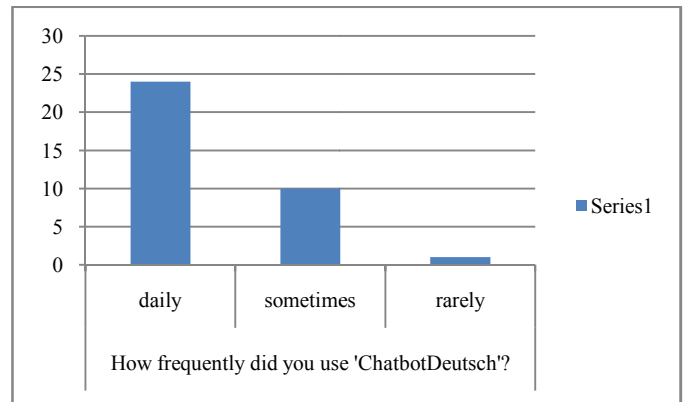


Figure 9 Frequency of usage of 'ChatbotDeutsch'

From table 2 and figure 9 above, it is clear that 68.6% of the students had used 'ChatbotDeutsch' daily to learn and practice German grammar and this only augments anytime, anywhere learning at the students' pace of learning itself thus extending the exposure to target language from within the walls of the classroom.

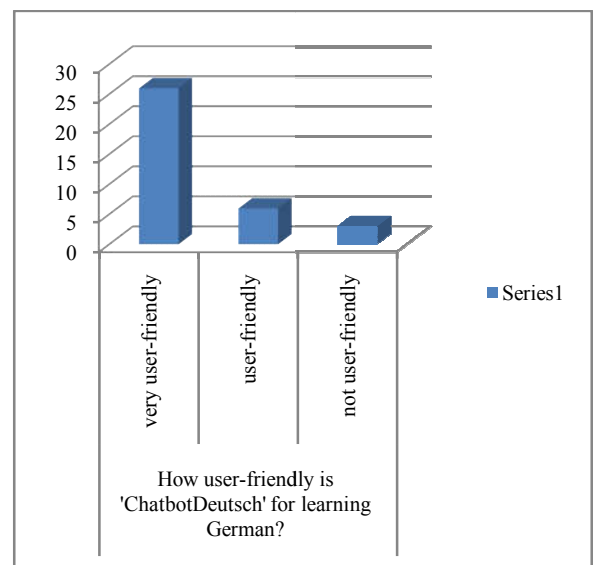
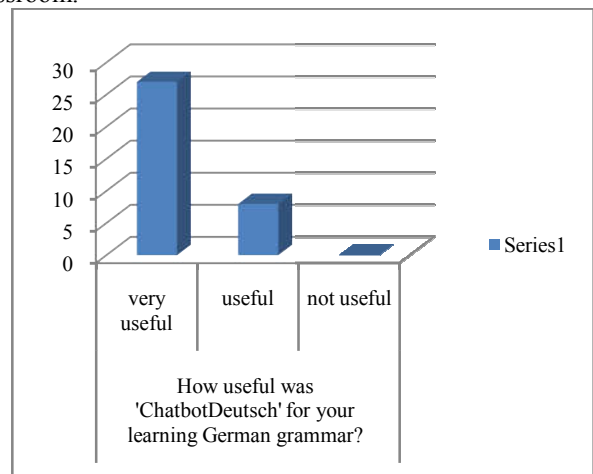


Figure 10 Usefulness and User-friendliness of 'ChatbotDeutsch'

As shown in Figure 10 above, with 77.14% of the students and 74.26% of the students considering 'ChatbotDeutsch' to be *very useful* and *very user-friendly* respectively only highlights the fact that 'ChatbotDeutsch' caters to the motivation and unconditioned learning requirements of the learners compared to the conditioned, structured instructions given in the classroom.

"Chatting with the bot and learning articles and basic sentences were easy and I could ask for the same word 'n' number of times" wrote a student as an answer to the qualitative question asked about the three things they liked in 'ChatbotDeutsch'.

"It was fun using 'ChatbotDeutsch' and I learned the plurals and articles easily. It took time to figure out how to text the bot and learn from it but it was interesting" wrote another student in his feedback.

From all these it is very evident that 'ChatbotDeutsch' has garnered the attention of the learners and has motivated them to try it again outside the classroom there by paving way for learner autonomy and self-learning.

Advantages of 'ChatbotDeutsch'

Based on this study, various advantages to the learners and the teacher can be inferred and a few of them are as listed below: The entire design and development of 'ChatbotDeutsch' being undertaken by the learners themselves has made the Chatbot more dynamic and robust, meeting the learning needs of them. Engaging in a meaningful task where they try to use and bring the language for a real purpose in a creative way enables learning to happen not only in the foreign language but also in the technical aspects.

It has also augmented the technical skills of the engineers who designed the bot as they had to learn, test and try the methods and execute the learning successfully to create a working model.

Collating and compiling the word list in English and German helped the learners to fortify and learn more both German and English grammar concepts.

All these tasks related to creating a working Chatbot as a collaborative project, enabled them to learn a lot of soft skills required for the smooth completion of the task within the stipulated time (one semester)

The interdisciplinary nature of the project fostered a lot of student-teacher interaction, teacher-teacher interaction and student-student interaction.

With the German books being completely monolingual, understanding the meanings of them is very difficult for the beginners and since they learn German after learning English, the learners often look for commonalities between the languages to understand the target language easily. This is highly facilitated by the Chatbot which returns answers to their query in both English and German.

The Chatbot acts as a ready reckoner for the grammatical concepts dealt in class and extensive use of computers by the students makes this learning easy for them.

The apprehension of the teacher mistaking their repeated clarification of doubts or the peer pressure of being mistaken as slow learners is resolved through the Chatbot.

Thus 'ChatbotDeutsch' brings in a positive psychological change among the learners by building their motivation and self-confidence in learning and speaking a new language.

Limitations and Challenges

To start with, the Chatbot retrieved answers based only on those few keywords like 'singular', 'plural', 'conjugate' etc. If any other unknown words were used it returned 'I did not understand the query' messages. This was the case for the nouns/verbs queried too, for the corpus was created based on the A1 level German book followed at that time by the class.

"I wished the Chatbot could talk and teach me how to say these words in German too" wrote a student when asked about areas of improvement in 'ChatbotDeutsch' and another had commented that *'Probably would be good if the design and layout of the texts were changed'*.

Scope for further experimentations

The initial observations being positive and considering that the students also wish to see the Chatbot fully developed with additional features, further expansion of the Chatbot is being contemplated. With necessary funding and support, a more comprehensive Bot with speech recognition facilities and machine learning technology could be developed to incorporate various modules of German grammar, which can then be easily used to learn German grammar by all levels of learners at their own pace and place. To make this as an ongoing project involves more administrative support, funding and student strength. More students from various branches and years have to be involved to further develop this Chatbot in all spheres.

CONCLUSION

The development of Chatbot by the learners for the learners has made learning of German grammar easy and interesting. It has clearly provided an avenue for anytime anywhere learning, thereby increasing the motivation of the learners to use the target language apart from the classroom. As explicated through this study, it has also facilitated in the application of their technical knowledge to develop a tool that augments their foreign language skill. In an Indian scenario, such applications aid in bringing a paradigm shift from a teacher – centric instructional approach to student-centric approach. It also enhances learner participation in language tasks, learner engagement and learner autonomy. Chatbots help in developing differentiated materials for the learners and becomes a perennial source for practicing the target language by being an 'instant help' through 'personalization'. The increase in test scores within a short period of time after the intervention was given stands testimony to this. Although Chatbots and their application in the educational sector are only emerging in Indian scenario, they have an enormous potential in making the learning process more personalized and learner-centric. Developing tailor made Bots to meet the learners' language needs especially while learning foreign languages will certainly fortify their language skills and make them a lifelong learner. Within this context, as elucidated by this study, Chatbots are certainly a unique platform for next level of language learning.

References

1. Behera, Bibek, 2016. "Chappie – A semi-automatic intelligent Chatbot.", https://www.cse.iitb.ac.in/~bibek/WriteUP_2016.pdf
2. Bhargava, Vishal and Maheshwari, Nikhil, 2009. "An intelligent speech recognition system for education system." (<https://pdfs.semanticscholar.org/8ea7/725bab4e390e4d8ab8ebee747d2a5340c3b2.pdf>)
3. Fryer, Luke and Carpenter, Rollo, 2006. "Emerging technologies: Bots as language learning tools". *Language Learning & Technology*, vol. 10, no. 3, pp. 8–14. (<http://home.cc.gatech.edu/ccl/uploads/63/emerging.pdf>)
4. Jia, Jiyu and Chen, Weichao, 2009. "The further development of CSIEC project driven by application and evaluation in English Education." *British Journal of Educational Technology*, vol. 40, no. 5, pp. 901-918.
5. Komawar, Om, Thakur, Prasad, Shetty, Rohit, Bartakke, Akshay, Desai, Manisha, 2015. "An Internet Relay Chat Bot using AIML." *IJSR*, vol. 4, no. 10, pp. 1739-1741.
6. Ming, Yue. And Bai, Zongshan, 2011. "A Mandarin e-learning system based on speech recognition and evaluation." *Comput. Appl. Eng. Educ.*, vol. 19, pp. 651–659. doi: 10.1002/cae.20349
7. Okumoto, Hiroaki, 2004. "Japanese Transitive and Intransitive Verbs: e-Learning System with Speech Recognition and Video." In L. Cantoni & C. McLoughlin (Eds.), *Proceedings of ED-MEDIA 2004--World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 1902-1907). Lugano, Switzerland: Association for the Advancement of Computing in Education (AACE).
8. Rosmalen, Van P, Eikelboom, J, Bloemers, E, Winzum, Van K, & Spronck, P, 2012. "Towards a Game-Chatbot: Extending the Interaction in Serious Games." 6th European Conference on Games Based Learning, 4-5 October 2012, Cork, Ireland. (<http://dspace.ou.nl/bitstream/1820/4308/1/ECGBL2012-chatbot-project-v11062012.pdf>)
9. Shawar, Bayan Abu, 2011. "A Chatbot as a natural web interface to Arabic Web QA." *iJET*, vol. 6, no. 1, pp. 37-43.
10. Weizenbaum, Joseph, 1966. "ELIZA—a computer program for the study of natural language communications between man and machine." *Communications of the ACM*, vol. 9, no. 1, pp. 36–45.

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