ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

WRITINGTUTOR IMPROVING A CONVERSATIONAL LEARNING TOOL

BACHELOR PROJECT REPORT, COMPUTER SCIENCE, B.SC

Written by Luca S. Engel, supervised by Thiemo Wambsganss and Tanja Käser

6th January 2023

Contents

ABSTRACT

Writing skills are essential during education and in work life. To improve these skills, students must receive feedback on written texts. However, due to increasing class sizes, large university classes, and massive open online courses, the quality and amount of individual feedback can suffer. At the same time, with the rapid growth of Machine Learning and Natural Language Processing, chatbots are becoming more powerful, and researchers are finding more implementation areas for them.

Therefore, the existing chatbot WritingTutor has been improved in this project. This chatbot interactively teaches students how to write convincing essays and uses multiple text analysis models to provide feedback for written texts. Those models include text summarization, polarity and subjectivity analysis, and emotion analysis.

This project seeked to determine how one should design a chatbot to support students when writing and how such a design influences their learning experience. The participants' feedback in an unrepresentative evaluation at the end of this project showed that providing the users with an intuitive design and letting them decide the learning pace and theory parts enhances the user experience.

Also, it is essential to provide students with feedback on their texts. In the evaluation, participants underlined the importance of receiving reasons for the assessment results given by the program. WritingTutor supports that by highlighting the most decisive sentences in the text. More than 80% of the participants believed that this was a helpful feature.

Chapter 1

Introduction

1.1 Relevance and Problem

Written communication skills are important when working on a job or seeking one. In 2022, the National Association of Colleges and Employers (NACE) surveyed employers in the USA about their hiring preferences for college graduates. They found that 73.3% of employers seek people with strong written communication skills. What is also noticeable is that verbal communication skills have become less important, dropping from 73.2% in the previous year to 58.8%. The authors believe that this might result from decreased face-to-face interactions. [1]

In an increasingly digital world, written communication skills will remain at the top, as they are important for reports, business documents, emails, etc. However, a writing assessment conducted by the National Center for Education in the USA found that only 24% of eighth graders performed at a proficient and 3% at an advanced level. [2]

At the same time, as stated by Rainer Winkler et al., not only is the number of students in school classes growing, but universities are seeing an influx of students taking online courses. In addition, massive open online courses with "more than 1000 participants" are increasing. This leads to decreased interaction and feedback between students and their teachers making it harder to learn and improve skills. [3]

Therefore, there exists a need to help students improve their written communication skills. Chatbots can help improve such skills, reduce the strain on the teaching staff and increase individualized feedback.

1.2 Proposed Solutions and Research Questions

This project focuses on chatbots as conversational learning tools to help students improve their writing skills. Chatbots could be a good addition to a teacher's input as the interaction between students, and teachers are generally limited to class hours. Additionally, chatbots allow instantaneous feedback on written texts, while teachers generally cannot do that for entire classes and can only give individual feedback after some time. Therefore, in the span of this project, the development of WritingTutor [4] was continued. WritingTutor is a chatbot that provides students with theory inputs into essay writing. It contains a practical part where the user writes an essay and receives feedback on it with the help of Machine Learning based text analysis models.

This project, therefore, has been designed to investigate the following questions further:

1. How should one design a chatbot to support students in general writing tasks?
2. How does the chatbot design influence students' learning experience?

By answering these questions, groundwork can be laid upon which future programmers can base their chatbot design so that the users have a higher and more enjoyable learning effect.

CHAPTER 2

LITERATURE REVIEW

The following will present the most important literature concerning conversational learning tools and writing support in education.

2.1 CONVERSATIONAL LEARNING TOOLS AND CHATBOTS IN EDUCATION

2.1.1 ARGUETUTOR

ArgueTutor [5] is a german chatbot aiming to improve students' writing and argumentation skills. It "guides students through a writing exercise with the aim to imitate a human educator." To imitate the interaction with a human educator, students can ask questions by writing into the chat and receive answers from the chatbot. After completing the task, the students receive tailored feedback on their essays and can decide to improve the written text.

The chatbot uses an argumentation mining model to provide feedback on the student's writing. Argumentation mining is a technique to extract arguments from a text, allowing a program to infer the structure of an argument. [6] This allows ArgueTutor to provide feedback to the students regarding their argumentation skill level, as seen in Figure 2.1. It is done by pointing out different argumentative structures in the text and analyzing these parts.

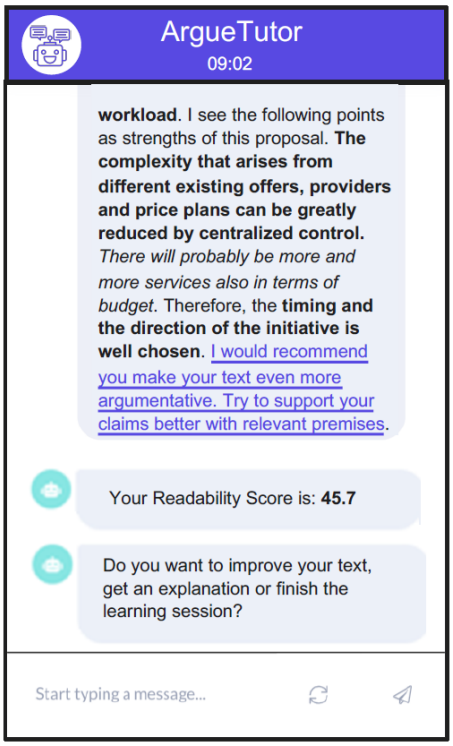


FIGURE 2.1
ArgueTutor: Text Feedback Example [5]

The study conducted by this team has found that not only was the perceived learning and enjoyment of the process of the students higher, but also the quality of their texts was higher than the control group using an alternative, nonadaptive learning tool where the students received "theory input and general recommendations on the argumentation of a given text." [5]

2.1.2 CHATBOT DD

Michael Pin-Chuan Lin and Daniel Chang [7] have developed a chatbot that helps students when writing thesis statements and peer review feedback. It also supports the teacher in explaining the writing instructions.
In an experiment, they tested the difference between using this chatbot and not using it. Two groups of students had two weeks to write an essay, and one group used the chatbot. The paper concludes that the group using the chatbot had statistically better scores than the one that didn't. However, they say those findings "should be interpreted with caution". For instance, they mention that no pre-test had been administered.

2.2 WRITING SUPPORT IN EDUCATION

Writing Support Circles are a way for students to improve their writing by receiving theory inputs and exchanging their knowledge with others in the support circle. Maria S. Plakhotnik and Tonette S. Rocco [8] created such a circle to see how it should be designed and how students experience it. In this experiment, every session included a short theory input followed by reviewing written assignments the participants had handed in beforehand. The sessions were guided by a facilitator responsible for presenting the theory inputs. An important takeaway of this study was that such a support circle needs to meet over an extended period since the participants had a hard time taking critique from the facilitator. The article states, "it takes time to learn to receive feedback in a constructive and nondefensive way". [8] Also, Wendy Larcombe et al. [9] have evaluated the effectiveness of writers' circles and found that it was essential to have a "non-judgmental environment" and experienced facilitators in those groups. They conclude that writers' circles are a good addition to conventional programs.

CHAPTER 3

METHODOLOGY

The design of WritingTutor has followed an iterative and incremental design approach. This widely spread method allows the developer to add features and plan the development process iteratively. Every iteration represents a cycle involving planning, designing, implementing, testing, and reviewing. [11] One of the main reasons this approach was chosen for this project is that it forces the developer to break down the additions into smaller changes that can be reviewed after completion. Breaking down the additions into smaller increments makes it easier to set priorities and adapt the implementation if any difficulties arise. Much like in a Scrum development process, after every iteration in this project, there was a working product of the program containing the new increment that could be tested and reviewed. [12] In this project, every iteration consisted of a new feature, such as adding text analyzation models or enabling text highlighting.

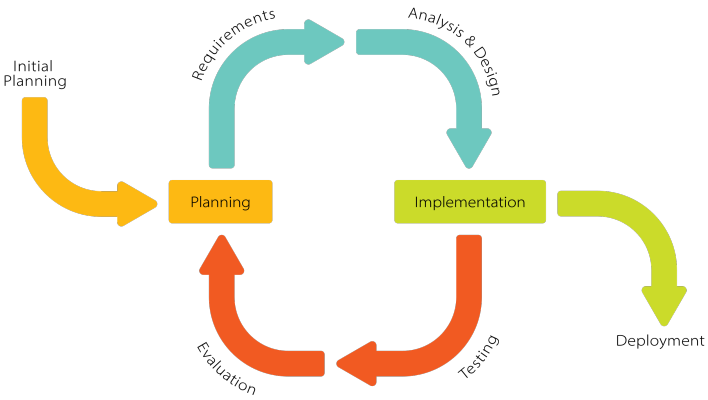


FIGURE 3.1
Iterative Process Diagram [10]

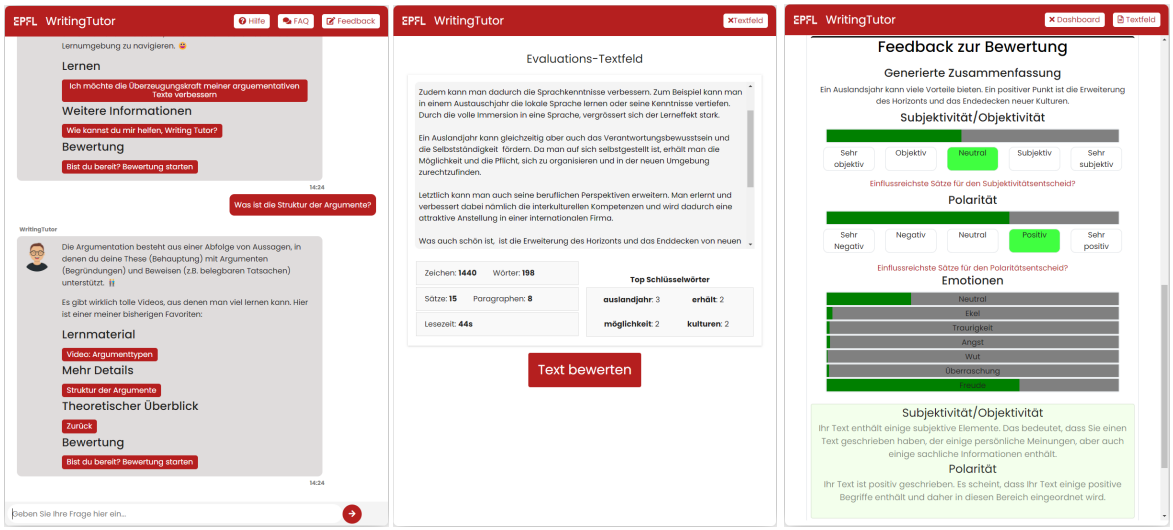
Previous to this project, the back end [13] and the front end [14] of WritingTutor had been designed and tested in a study that included receiving feedback on the product from the participants. [4] This feedback was used to help prioritize what features would be added to this project's scope. In addition to the improvements based on the survey, this project also focused on the program's ease of maintainability and flexibility in the future. This is why, in the first step, the front end was rewritten to use ReactJs, a JavaScript library for building user interfaces. [15]

Toward the end of this bachelor project, another user study was conducted to assess the improvements and how they affected the user and learning experience. With the help of this feedback, WritingTutor's further development will be based on a new prioritization of features to adapt and improve the program.

CHAPTER 4

DESIGN

In the following, the design of WritingTutor is explained, and the improvements are compared to the last version of the chatbot.



(A) Chat Interface (B) Writing Interface (C) Evaluation Interface

FIGURE 4.1
WritingTutor User Interface

4.1 PROGRAM FLOW

As depicted in Figure 4.1, the program flow is structured into three main parts. The first part is the chat interface. There, the chatbot conveys the theory needed for the writing exercise. It consists of videos, text explanations, and documents. Here, the users can select which theory parts they want to learn more about and ask questions through the chat interface for further explanations. In the second part, the users write their essays. Finally, the users can evaluate their reports. After the written text has been evaluated by the chatbot, the users find the assessment and feedback of the text in the third part, the evaluation interface.

4.2 DESIGN CHOICES

WritingTutor was originally designed in HTML5, CSS, and JavaScript and tested in a laboratory experiment to see how increased learner control affected the learning outcome. [4] In this project, however, the focus was on increasing the flexibility of adding new features to the bot, such as providing more feedback on the written text and improving the user experience with ease of use. Therefore, the front end has been rewritten to use ReactJs [15], and some learner control features, such as the ability to choose a background color, have been removed. The main reason for using ReactJs was to increase flexibility and allow for more manageable implementations of additional features

In every iteration of the design process, a new feature was added, and at the end of it, the code's functionality was checked and improved when necessary. Using the feedback from the survey conducted before this project, a list of priorities for the features was set and implemented. Due to time constraints, the main focus was improving the front end and adding text analysis models to the back end.

4.3 MAIN IMPROVEMENTS BASED ON THE SURVEY

In the survey of the laboratory experiment conducted before this project, [4] one of the most requested features was the ability to switch back and forth between the chat interface and the writing interface. This would enable the users to go back and ask for clarification without losing their progress. Additionally, many requested for the dashboard to be extended. In the previous version, the users only received a subjectivity and polarity score for their texts without any reasoning. The participants in the study underlined that it would be helpful to know which parts of the text influenced the evaluation. [4] In the new iteration of WritingTutor, the users are free to switch between the writing interface and the chatbot interface. They can also go back to their texts once they have been evaluated to improve and reevaluate them.

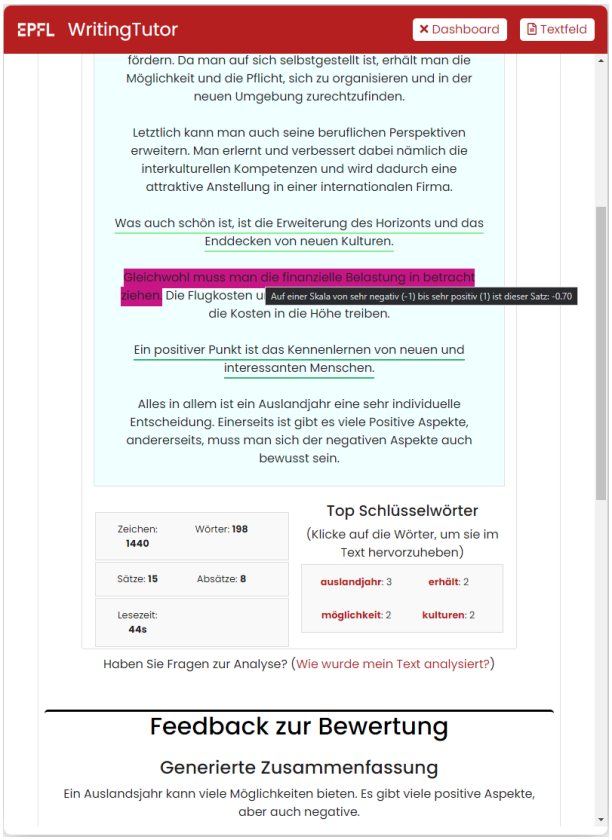


FIGURE 4.2
WritingTutor: Polarity Text Highlighting and Generated Summary

Also, multiple features have been added to the Evaluation Interface. In addition to subjectivity and polarity, the feedback now also gives an insight into the emotions contained in the text. To address the complaint of the evaluation not telling the user how the subjectivity and polarity scores have been calculated, a feature has been added that allows the user to see the sentences with the most decisive influence on the outcome highlighted in the text. As seen in the black bar shown in Figure 4.2, the user can find out how those sentences were weighted by hovering over them. This figure also displays the generated summary ("Generierte Zusammenfassung") of the written essay shown in the evaluation interface.

Chapter 5

Implementation

The front end of WritingTutor is responsible for the User interface. It sends the questions and text of the user to be analyzed and handled to the back end, which answers with the appropriate response. Previous to this project, the chatbot was implemented using Chatomatic, [16] a python library for creating chatbots. [13] Both Chatomatic and the analyzation models do the computation in the program's back end.

5.1 Front End

Based on the user input, the front end displays one of the three interfaces (chat, text writing, evaluation). As seen in Figure 4.1, switching back and forth between those three interfaces is enabled with the buttons in the header and those displayed in the chatbot's messages.

5.1.1 Chat Interface

In the chat interface, shown in Figure 4.1a, the user questions are sent to the backend and then, together with the corresponding response by the backend, added to the chatbox. The responses of the back end contain text and buttons which the user can click to continue the interaction. Videos and PDFs can be displayed within the chat interface if the user requests them. When the user clicks on the button that says "Textfeld öffnen", which translates to "open text field", the front end switches to the writing interface and lets the user write the text.

5.1.2 Writing Interface

Figure 4.1b shows the writing interface. This interface has limited interaction between the program and the user. The user can close the text field and return to the chat to ask questions or evaluate the text. Other than that, the program only updates the statistics of the text, such as the word count and the most used keywords. Once the user clicks the evaluation button, the front end sends the written text for analysis to the backend. The front end switches to the evaluation interface as soon as the text has been evaluated.

5.1.3 Evaluation Interface

The evaluation interface, shown in Figure 4.1c, offers multiple interactive features. Firstly, it allows the user to switch back to the writing interface by clicking on the "Textfeld" (text field) button, shown in Figure 5.1, to adapt the written text and reevaluate it based on the provided feedback.

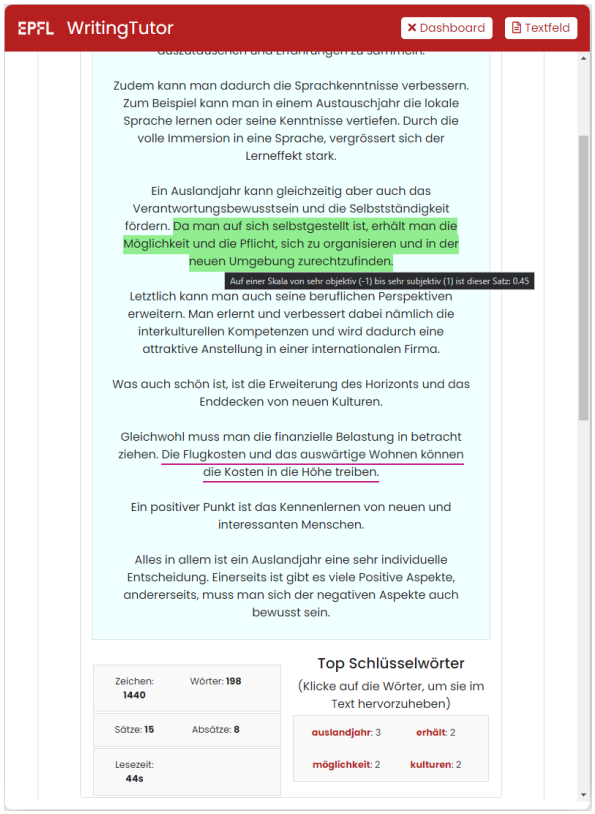


FIGURE 5.1
WritingTutor: Most Influential Sentences for the Subjectivity Assessment

Secondly, it enables text highlighting. This was implemented as follows:

The user can press on one of the keywords ("Top Schlüsselwörter") to see its locations highlighted in the evaluated text or can decide to see the most influential sentences for the polarity or subjectivity assessments. To do that, the user can click on the sentence below the subjectivity or polarity section colored red. They are shown in Figure 5.2.
Once the user clicks on the text, the most influential sentences are highlighted in the evaluated text. This is shown in Figure 5.1.

FIGURE 5.2
WritingTutor: Clickable Text to Enable Highlighting

If the user clicks on one of the keywords, this keyword is searched for in the text area and highlighted by placing it into an HTML span element containing a class name that allows text highlighting to take place. If instead, the user asks for the most influential sentences for the subjectivity or polarity result, the front end picks those sentences and, similarly, highlights them. The main difference compared to keyword highlighting is that the color of the highlighted sentence adapts to the value associated with it. Sentences evaluated as subjective or positive are highlighted in tones of green, while sentences considered objective or negative receive a red tone. Neutral sentences are highlighted in a grey tone.

Always the two most influential sentences are picked for the text highlighting. Suppose a text is evaluated as "very subjective". In that case, the two most subjective sentences will be highlighted, while if it is assessed as neutral, both the single most subjective and the single most objective sentences are highlighted.

If the text, however, is interpreted as being only "subjective" or only "objective", in addition to the two sentences being highlighted in the same way as described above for a very subjective or objective essay, a third sentence is highlighted. This third sentence is the one with the strongest evaluation in the opposite direction. This means that, for instance, the two most subjective and the single most objective sentences will be highlighted for a subjective text. That way, the user can better understand the result of the evaluation.

5.2 BACK END

WritingTutor is a German chatbot; therefore, German text analysis models are needed to evaluate the essays. However, since there are fewer german text analysis models than English ones, the possibilities for text analysis in German are limited. For instance, TextBlob [17] can be used to analyze texts for polarity and subjectivity in English; however, for german texts, only polarity analysis is supported at the moment. [18] For that reason, WritingTutor translates the German text into English using Google Translate so that the analysis can be done with a working English model.

5.2.1 TEXTBLOB

TextBlob is a Python library that offers a variety of Natural Language Processing methods. [17] In this project, TextBlob was used to analyze the polarity and subjectivity of the written text. In addition to running the subjectivity and polarity analysis on the entire text, it is also run on separate sentences, which have also been extracted from the text using TextBlob. This is done to find the most influential sentences for the polarity and subjectivity assessment. After running the analysis on the sentences, they are ordered by the score and sent to the front end so that the latter can highlight those sentences with the appropriate color.
As mentioned previously, the subjectivity of the texts is analyzed with TextBlob, while the polarity is assessed with its german counterpart, TextBlobDE. [18]

5.2.2 HUGGING FACE

Hugging Face is a company that offers a collection of Natural Language Processing tools and pre-trained models for such tasks. [19] In this project, two Hugging Face models have been used. The first is a text summarization model [20] that generates a summary of the provided essay. The second model analyzes the emotions conveyed in the text. [21] The evaluated percentages of the emotions and the generated summary are displayed alongside the polarity and subjectivity analyses in the evaluation interface as shown in Figure 4.1c.

CHAPTER 6

EVALUATION

This project was evaluated in two ways. The first was a continuous evaluation coming from the iterative design approach. The second way was a field study conducted at the end of the project. This study included a survey that the participants filled out after using the chatbot to assess how helpful it was and what could be improved.

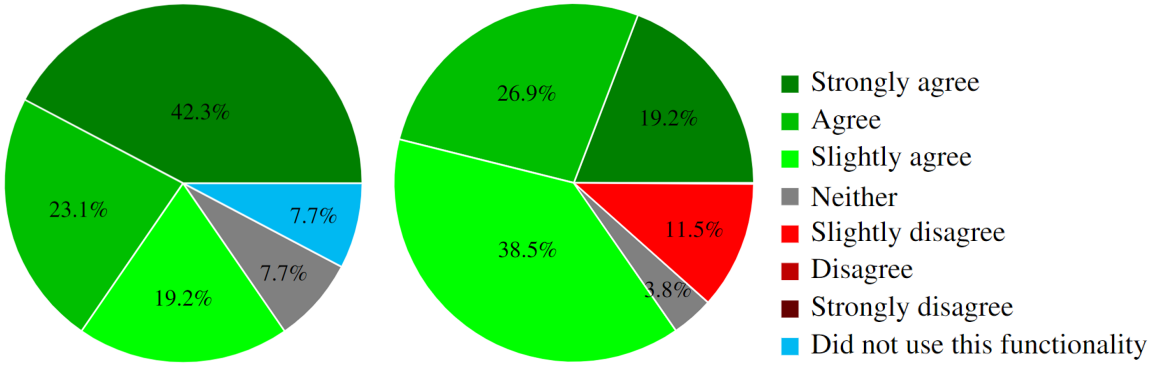
6.1 CONTINUOUS EVALUATION

After every iteration, the project was tested and evaluated. The goal was to find any bugs and potential problems that needed fixing. Those tests mainly consisted of going through the different stages to check if the program behaved as intended. With the help of feedback on those small tests, new priorities for the subsequent iterations could be fixed, and bugs could be minimized.

6.2 FIELD STUDY SETUP

The field study for this project was conducted with 26 participants. First, the participants, guided by the chatbot, learned about the theory of writing persuasive texts. Here, the users could ask questions by writing them in the text field or clicking on the buttons provided inside the chatbot's messages to choose what kind of theory they would like to learn about. Then they wrote an essay containing around 250 to 300 words and evaluated it. This evaluation included a summary, subjectivity and polarity analysis, and emotion analysis. Once the interaction with the program was over, the participants filled out a google survey to provide feedback on the user experience, how they assessed the evaluation of their text, and what should be adapted or added in future iterations of this program. The results of this survey are presented in the following.

6.3 FIELD STUDY FEEDBACK



(A) Sentence highlighting for subjectivity and polarity scores helped me understand how my essay was evaluated.

(B) The feedback on my essay was helpful.

FIGURE 6.1
Field Study Feedback

Most participants stated that WritingTutor was very user-friendly and had an intuitive user interface. When asked if they enjoyed using WritingTutor, 92.4% agreed, of which 38.5% strongly agreed. Also, the participants appreciated the quickness of the interaction and the evaluation.

To compare the evaluation with the user's expectation, the participants were asked if they agreed with the assessment of their essay. Also, in this question, a large majority concurred. In total, 88.5% agreed with the evaluation, and 7.7% slightly disagreed. One person stated that they neither agreed nor disagreed. Additionally, as shown in Figure 6.1b, most participants found the feedback on their essays helpful.

Many participants liked the highlighting functionality in the evaluation interface. For instance, one person mentioned that highlighting the top keywords was helpful. It allowed them to find their locations in the text quickly and use synonyms to avoid unnecessary repetition. Others stated that seeing the most important sentences concerning polarity and objectivity helped them better understand the evaluation. The "did not use this functionality" option that two people selected in Figure 6.1a was added to see if the participants in the study realized that the program had a highlighting functionality to show the most influential sentences in the text for the polarity and subjectivity assessment.

CHAPTER 7

DISCUSSION

In this chapter, the results of the second evaluation of WritingTutor will be analyzed. Then its current limitations will be presented, and possible future additions to improving WritingTutor will be discussed.

7.1 FEEDBACK OF THE SECOND SURVEY

The following section synthesizes the feedback from the second survey conducted toward the end of this project. As the evaluation of this project was only conducted with 26 participants and the sample is not representative of the general population, the results of this survey are not statistically relevant. For instance, 92.4% of participants found that WritingTutor's user interface is intuitive. This number, however, might be lower in a representative survey since nearly 90% of them stated that they like trying out new technologies and, therefore, more easily adapt to new designs. Nevertheless, thanks to the feedback, it is still possible to decide what parts of the program are appreciated by the users and what may need further adaptation. For instance, one user stated that it would be useful to see the problem statement for the essay displayed above the text field while writing it. That way, the user would not have to switch to the chat interface to read the problem description.

As mentioned in Chapter 6.3, most of the participants agreed with the evaluation provided by the text analysis models. However, some participants mentioned inaccuracies in the assessment. For instance, one person stated having received a neutral evaluation concerning the polarity of the text while having written a negative one. On the one hand, such discrepancies could be because the participants did not correctly assess their text, and on the other hand, this could come from the fact that the models contain certain imprecision. For instance, according to the developers, the evaluation accuracy of the emotion analysis model is 66% [21], which could also explain why specific essays may have had some misleading results.

Another important aspect is the program design's influence on the program's user experience and intuitiveness. Concerning the user experience, many participants mentioned that they liked the design of the user interface and its ease of use. Also, one participant mentioned that interactively learning the theory was very useful. Not only could they control what to learn but also the speed at which the information was taught.
Concerning the program's intuitiveness, a large majority (92.4%) of participants found this to be the case. However, two people stated that they had not understood that it was possible to highlight sentences with a decisive influence on the polarity and subjectivity assessment in the evaluated text. Therefore, it seems worthwhile to consider changing the evaluation interface to make that feature more evident to users.

7.2 CURRENT LIMITATIONS OF WRITINGTUTOR

One of the main limitations is the chat functionality when the users write their questions into the chat. Sometimes, the chatbot's answer does not correspond to the written question. For instance, the question "Können wir den Bewertungsprozess starten?" leads to the intended answer where the chatbot explains the problem statement for the essay. However, the question "Können wir die Bewertung starten?" leads to a theory input by the chatbot. These sentences roughly translate to "Can we start the evaluation?". Such discrepancies could be reduced by training the chatbot with more sample sentences.

Also, as mentioned before, the availability of german text analysis models is limited. As a result, the text has to be translated into English to allow more models to be used. This, however, increases the likelihood of inaccurate analyses since there could be translation errors in addition to the models making false conclusions. Nevertheless, based on the feedback from the survey, WritingTutor shows promising results concerning chatbots in education.

7.3 FUTURE WORK

This project has many elements that can be added and improved. In the following, the most important ones of them are pointed out.

7.3.1 MULTILANGUAGE SUPPORT

Multilanguage support would be a handy feature. It would allow users to expand their essay writing skills from German to other languages. Such a feature would require minor changes in the front end so that, for instance, the text on the buttons to switch between interfaces would be displayed in the correct language. What would require more changes is the back end. On the one hand, the text analysis models would need to be adapted to support the new language. On the other hand, the Chatomatic part would require changes to answer questions in the new language.

7.3.2 MULTIPLE SORTS OF TEXT

Another interesting addition would be support for different kinds of texts. This could include Reports, news articles, Emails, and many more. In such an addition, for example, the users could decide what sort of text they would like to improve at the beginning, after which the answers and theory inputs of the chatbot would focus on the selected theme.

7.3.3 MORE FEEDBACK ON THE WRITTEN TEXT

Another interesting aspect could be the addition of more feedback for the written text. Multiple participants of the evaluation of this project stated that they would have liked a similar text highlighting feature in the evaluation interface for the emotions as with the polarity and subjectivity sections. That way, they could better understand the results in the emotions section. Additionally, the evaluation could provide the user with more detailed explanations of how the model arrives at its conclusion or suggestions on adapting certain sentences to change the assessment. For instance, rewriting negative sentences to make them more positive.

Also, analyzing the text using Argumentation Mining might provide helpful feedback to users as they would have more insight into their argument structures and could, for instance, add more supporting arguments depending on the received feedback.

7.3.4 IMPROVE MOBILE VERSION

Currently, using WritingTutor with a mobile phone works and has the same functionality as when accessing it from a computer. However, as the screen on the phone is smaller than on a computer, there is less space available for the buttons, the chat, etc. Currently, certain parts are not displayed correctly on phone screens because of this lack of space. For instance, the buttons in the header overlap with the name "WritingTutor". By addressing such issues, users would have a good alternative to accessing the chatbot on the laptop and could, for example, use it while traveling or commuting. This option would be handy for practicing writing shorter texts, such as Emails.

CHAPTER 8

CONCLUSION

In the course of this project, the development of WritingTutor continued. By rewriting the front end in ReactJs and adding additional features to improve the evaluation, the overall user experience and text analysis were much improved.

This project has sought to determine how to design a chatbot to support vocational students in general writing tasks. The field study and survey have clarified what aspects of the current version of WritingTutor are helpful and which ones need improving. Namely, specific feedback and reasons for the given assessment are essential for the user to understand why their text is evaluated in a particular way. For instance, highlighting sentences in the written text to show the most decisive parts of the essay for the evaluation provides the users with valuable insights into their texts. Also, with the help of the interactive chat functionality, users can adapt the learning pace and the content taught to their personal needs and preferences.

Additionally, this project has examined how the chatbot design influences students' learning experience. Concluding from the evaluation, providing the user with an intuitive and easy-to-use user interface is essential. This allows the user to focus on the task without wasting time learning how to use the chatbot. Additionally, quick and accurate responses to the user's input are highly valued. In the evaluation, many participants appreciated the immediate evaluation of their essays. Finally, this project lays out possibilities for future iterations of WritingTutor and provides insight into the considerations required when designing a chatbot for students.

Lastly, this project has shown that chatbots can adapt to students' requests and learning habits and provide them with instant feedback on their texts. In the future, with better natural language processing models, text analysis will improve, and chatbots like WritingTutor will offer a good addition for students to enhance their writing skills.

BIBLIOGRAPHY

[1] Andrea Koncz and Kevin Gray. *The Attributes Employers Want to See on College Students' Resumes*. National Association of Colleges and Employers. 2022. URL: https://www.naceweb.org/about-us/press/the-attributes-employers-want-to-see-on-college-students-resumes/ (visited on 3rd Jan. 2023).

[2] National Center for Education. *The Nation's Report Card: Writing 2011*. 2012. URL: https://nces.ed.gov/nationsreportcard/pdf/main2011/2012470.pdf (visited on 4th Jan. 2023).

[3] Rainer Winkler, Matthias Söllner and Jan Marco Leimeister. *Enhancing problem-solving skills with smart personal assistant technology*. 2021. URL: https://doi.org/10.1016/j.compedu.2021.104148 (visited on 4th Jan. 2023).

[4] Thiemo Wambsganss and Tanja Käser. *Effects of Learner Control Features in Designing Conversational Tutoring Systems*. Working Paper. 2023.

[5] Thiemo Wambsganss et al. *ArgueTutor: An Adaptive Dialog-Based Learning System for Argumentation Skills*. CHI '21: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. 2019. URL: https://dl.acm.org/doi/10.1145/3411764.3445781 (visited on 29th Dec. 2022).

[6] John Lawrence and Chris Reed. *Argument Mining: A Survey*. Computational Linguistics. 2019. URL: https://doi.org/10.1162/coli_a_00364 (visited on 30th Dec. 2022).

[7] Michael Pin-Chuan Lin and Daniel Chang. *Enhancing Post-secondary Writers' Writing Skills with a Chatbot: A Mixed-Method Classroom Study*. 2020. URL: https://www.jstor.org/stable/26915408 (visited on 2nd Jan. 2023).

[8] Maria S. Plakhotnik and Tonette S. Rocco. *Implementing Writing Support Circles With Adult Learners in a Nonformal Education Setting: Priority, Practice, and Process. Adult Learning, 23(2), 76–81*. 2012. URL: https://doi.org/10.1177/1045159512443507 (visited on 2nd Jan. 2022).

[9] Wendy Larcombe, Anthony McCosker and Kieran O'Loughlin. *Supporting Education PhD and DEd Students to Become Confident Academic Writers: An Evaluation of Thesis Writers' Circles*. 2007. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2126912 (visited on 2nd Jan. 2022).

[10] Krupadeluxe. *Iterative Process Diagram, CC BY-SA 4.0*. License: "CC BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0, via Wikimedia Commons". Wikimedia Commons. 2021. URL: https://commons.wikimedia.org/wiki/File:Iterative_Process_Diagram.svg (visited on 3rd Jan. 2023).

[11] Kate Eby. *The Power of Iterative Design and Process*. 2019. URL: https://www.smartsheet.com/iterative-process-guide#:~:text=for%20Project%20Management-,What%20Is%20Meant%20by%20the%20%E2%80%9CIterative%20Process%E2%80%9D%3F,getting%20closer%20to%20the%20solution. (visited on 1st Jan. 2023).

[12] *Scrum Homepage*. 2022. URL: https://www.scrum.org/ (visited on 1st Jan. 2023).
[13] Thiemo Wambsganss and Seyed Parsa Neshaei. 2022.
[14] Thiemo Wambsganss. 2021.
[15] *React Homepage*. 2023. URL: https://reactjs.org/ (visited on 6th Jan. 2023).
[16] Seyed Parsa Neshaei. *Chatomatic*. 2022. URL: https://github.com/spneshaei/Chatomatic (visited on 6th Jan. 2023).
[17] Steven Loria. *TextBlob: Simplified Text Processing*. 2021. URL: https://textblob.readthedocs.io/en/dev/ (visited on 31st Dec. 2022).
[18] Steven Loria. *textblob-de README*. 2021. URL: https://textblob-de.readthedocs.io/en/latest/readme.html (visited on 30th Dec. 2022).
[19] *HuggingFace*. 2022. URL: https://huggingface.co/ (visited on 31st Dec. 2022).
[20] *Einmalumdiewelt/T5-Base$_{G}NAD$*. 2022. URL: https://huggingface.co/Einmalumdiewelt/T5-Base_GNAD (visited on 31st Dec. 2022).
[21] Jochen Hartmann. *Emotion English DistilRoBERTa-base*. 2022. URL: https://huggingface.co/j-hartmann/emotion-english-distilroberta-base/ (visited on 31st Dec. 2022).