P-ISSN: 2790-6795	Annals of Human and Social Sciences	October-Dec 2024,Vol. 5, No. 4
O-ISSN:2790-6809	http://doi.org/10.35484/ahss.2024(5-IV)41	[454-464]

Annals of Human and Social Sciences
www.ahss.org.pk

RESEARCH PAPER

Automated Sentiment Analysis of Linguistic and Emotional Dimensions in The Book of Dede Korkut and Fuzzy Logic

[1]Dr Summaira Sarfraz and [2]Namra Fazal*

1. Professor, Department of Science and Humanities, FAST National University of Computer and Emerging Sciences, Lahore, Pakistan
2. Lecturer, Department of Science and Humanities, FAST National University of Computer and Emerging Sciences, Lahore, Pakistan

Corresponding Author namra.fazal@nu.edu.pk

ABSTRACT

This paper applies fuzzy logic and sentiment analysis to examine the linguistic intricacies and emotional content within *The Book of Dede Korkut*. By focusing on hedges, epistemic elements, and attitude frequencies, the text's nuanced nature emerges, encompassing positive, negative, and neutral sentiments that reflect the narrative's diverse emotional scope. Fuzzy logic captures uncertainties in linguistic variables, highlighting subtle shifts in tone, while sentiment analysis classifies and measures attitudinal intensities throughout the text. Tables and figures illustrate the integration of these approaches, offering visual insights into complex language features and emotional nuances. The findings reveal a complex interplay between language and emotion, with fuzzy logic illuminating subtle language features and sentiment analysis refining the text's affective insights. Extending these approaches to cross-linguistic comparisons and broader historical contexts will deepen the exploration of classical literature's emotive resonance and further validate fuzzy logic based literary scholarship for future research.

Keywords: Dede Korkut, Emotional Content, Fuzzy Logic, Linguistic Variables, Literary Analysis, Sentiment Analysis

Introduction

Over the last several years, computers have found their ways into literary analyses, giving scholars more accurate tools to study texts (Vashishtha, Gupta and Mittal, 2023). From these tools, the two more specific approaches are fuzzy logic and sentiment analysis that can accommodate gradual changes in tone and emotional character of the text as opposed to strict classical language analysis (Karyotis, Doctor, Iqbal, James, and Chang, 2018). This paper aims at analyzing the Book of Dede Korkut using fuzzy logic and sentiment analysis because of its linguistic ambiguous nature, cultural importance and multiple narratives. As a result, the synthesis of this work proposed through an evolved prototype tool will revisit the pieces of the text from a linguistic and sentimental analysis, thus offering a novel perspective to its interpretative context (Serrano-Guerrero, Romero and Olivas, 2021).

Fuzzy logic a type of the range of the paradigms introduced in 1960s by Lotfi Zadeh provide some way to deal with the fuzziness of the natural language. It eliminates classical duality by permitting the truth value to range from 0 to 1, which is appropriate for dealing with the vagueness typical to literary works (Meriem, Hlaoua and Romdhane, 2021). In a broader sense, this research look at the linguistic constructs that add dimensions of fuzziness to the textual features of The Book of Dede Korkut using fuzzy logic. Traditional logic allows reviewing the metaphorical language, symbols, the spectrum of truth in the story, and the text's context sensitivity in terms of fuzzy truth (Chakriswaran, Vincent, Srinivasan, Sharma, Chang, and Reina 2019). The prototype designed for this study also identifies and evaluates the use of hedges based on linguistic variables and membership functions, as well as the concept of fuzzy sets.

To the above analysis based on the fuzzy logic, there is an equally effective sentiment analysis that is used in natural language processing to analyze the emotional inclinations of a text (Sharma, Singh, Agarwal, Pachauri, Alhussan, and Abdallah, 2023). There is also a conception formally named sentiment analysis that defines the disposition of textual content as positive, negative, or something in between; therefore, measuring the sentiment of a literary work is possible (Madbouly, Darwish and Essameldin, 2020). Using the method of sentiment analysis it is possible to find out what kind of emotions prevails during the reading of the Book of Dede Korkut: whether it contains rising and culmination, conflict and briefly overall downswing, or vice versa. Thus, by analyzing the distribution of the sentiment the study addresses questions of how text conveys the affective valence of the story, which is another layer of interpretation of the text.

The main goal of the work presented here is to demonstrate the proposed prototype tool on identifying patterns in The Book of Dede Korkut taking into account the possibility of applying fuzzy logic and sentiment analysis. More particularly, in this investigation, the researcher endeavor's to qualify the linguistic variables, hedges, and epistemic facets into the text through fuzzy logic (Prasanna, Shaila and Vadivel, 2021). This paper aims at finding out how the mechanics of the lingual uncertainty and looseness fit into the story. In addition, the analysis also uses the sentiment analysis tool to analyses the textual content and the result showing the percentage of positive, negative and neutral emotion during the narration. The relationship between the two linguistic constructs and the two forms of emotion representation discussed to show how the two paradigms of reading literature operate as counterparts.

In addressing the gap in current research, this study poses several key questions: In what manner can one use fuzzy logic to staff the linguistic variables and vagueness of The Book of Dede Korkut? Where and how often ambiguity and fluidity manifest does and what part do hedges and epistemic facets perform in this sense? What is the disposition of sentiments across the whole? How does overall disposition alter the reader's Concocted Reality? In what way does using fuzzy logic and sentiment analysis help gain additional insight as to the nature of the literary work than does' traditional analysis?

This research has a positive contribution to the nascent field of computational literary analysis. This feature highlights the possibilities of using fuzzy logic and sentiment analysis as methods for searching for latent semiotic codes in textual artifacts. That is why the given research is intended to demonstrate the significance of an interdisciplinary approach, bringing together elements of artificial intelligence prognosis and the analysis of the pre-romantic novel in order to reveal previously unnoticed tendencies (Qiu, Yu and Chen, 2024). The expected contribution of this study is to show how fuzzy logic captures the 'fuzziness' in literary language and sentiment analysis captures 'emotional' aspect of the text and thereby improve the understanding of The Book of Dede Korkut. Apart from the essential role of computational tools in literary analysis, it also offers directions for subsequent studies of additional intricate literary texts.

Literature Review

According to (Yan, Yu and Qiu, 2022) the applications of fuzzy logic analysis have been an area of interest in numerous disciplines, aimed to provide a tool of coping with vagueness and subtle shades of meaning existing beyond the strict patterns of black and white logic. Fuzzy logic finds its usefulness in analyzing shades of grey within human language which are not explicitly defined and sharpened within literary works (Kumar, Raghunath, Muthukumaran, Joseph, Beschi, and Uday, 2022). The use of fuzzy logic in analysis is especially relevant to The Book of Dede Korkut since this invaluable work reflects Turkic languages and culture saturated with metaphors, symbolism, and ethical questions (Saraswat, Chakraverty and Kala, 2020). Further, sentiment analysis has become an adjunct approach that allows one to understand emotional subtext in literature and providing

numerical estimates of sentiments expressed in the text (Wang, 2022). Fuzzy logic and sentiment analysis work together to form a multi-faceted model that is flexible and complex enough to handle the interpretation of literature, as will be seen in this literature review (Padmaja and Hegde, 2019).

According to (Vashishtha, Gupta and Mittal, 2023) Fuzzy logic was developed in 1960's by Lotfi Zadeh and intends to solve the vagueness which is immanent in human approach and language. In contrast to the rigid binary mathematical logic which can only accept 0 or 1 values traditional logic fails when it comes to analyzing language expressivity which necessarily involves values in between '0 and 1'. Fuzzy logic supplements this deficiency by permitting values between 0 and 1, applying the approach of the linguistic variables (Karyotis, Iqbal, James, and Chang, 2018). The subjects of studies of hedges, metaphors and modalities in the context of literary analysis as fuzzy logic makes fuller understanding the narrative and the depth of meanings that are behind the words possible (Kaminska, Cornelis and Hoste, 2023).

According to (Chakriswaran, Vincent, Srinivasan, Sharma, Chang, and Reina, 2019). Hedges, which in fuzzy logic are the cornerstone of the concept, have a large share in the story of ''The Book of Dede Kortuk'. Hedges are other words that qualify an utterance and typically include terms like: "possibly," "somewhat," "likely," and so on (Karyotis, Iqbal, James, and Chang, 2018). In literary texts hedges provided semiotic depth and versatility and are meaningful representations of the human experience and perspective (Arguedas, Xhafa, Casillas, Daradoumis, Peña and Caballé, 2018). There can certain features in The Book of Dede Korkut described by (Abdulla and Aliev, 2023). The use of hedges to vary and enhance the meaning in order to facilitate or aggravate the conception depending on the context. The level of being imprecise in the given text and uncertainty of Meanings is aligned with the narrative regarding the use of hedges, and untidy, as well as a fuzzy-logic approach (Chaturvedi, Satapathy, Cavallari, and Cambria, 2019). This aspect of fuzzy logic is crucial in order to examine how Dede Korkut 'consciously spills the milk' and discusses complex moral deliberations, and human interactions and values, with the help of linguistic variables (Nguyen, Kavuri and Lee, 2019).

According to (Bahreini, van der Vegt and Westera, 2019) fuzzy logic has been applied in control, pattern recognition, decision support, and various social sciences. Uncertainty is another advantage of the fuzzy logic in that it can be used in modeling systems with large uncertainties as well as in human-like activities (Padmaja and Hegde, 2019). In the social sciences, the uncertainty in human behavior and social processes well represented by fuzzy logic; this information is hard to obtain using analytical approaches (Megahed and Mohammed, 2020). According to (Abdulla and Aliev, 2023) is a productive example of how the concept of the fuzzy logic can be used even to examine one of the ancient stories like The Book of Dede Korkut, which suggests the possibility of convergence of a computational approach to reasoning and traditional folk tales. This cross-disciplinary approach reinforces the notion that fuzzy logic is ubiquitous, and this work aims to demonstrate how this concept used effectively in any discipline to reveal further meaningful layers (Vashishtha and Susan, 2020).

According to (Madbouly, Darwish and Essameldin, 2020) the second essential method is the opposite to fuzzy logic it is sentiment analysis that also can be used to analyze literary texts. One of the affordances of natural language processing technique is sentiment analysis whereby text is classified depending on the emotions it contains either positive, negative or neutral (Çakıt, Karwowski and Servi, 2020). In literary analysis, sentiment analysis allows for the measurement of the emotions contained in text – and by so doing, the emotions that play a role in the unfolding of the story (Serrano-Guerrero, Romero and Olivas, 2021). When it comes to The Book of Dede Korkut, the sentiment analysis gives the regularly spaced low and high points in the plot, when the something dramatic happens, when conflict arises, when resolution is achieved (Meriem, Hlaoua and Romdhane, 2021).

While in some way this quantitative approach to sentiment augments the qualitative work done in literary interpretation, it presents a foundational system for acknowledging the emotional subtext that colors the reader's experience of the text.

Material and Methods

In this particular research, a tool based on the fuzzy logic and sentiment analysis prototype used for the analysis of The Book of Dede Korkut. The resource is developed as a tool that combines linguistic analyses that engage the level of fuzzy reasoning and language understanding to incorporate emotions expressed in the literature with other elements of semantic analysis (Li and Tsai, 2013). The methodology involves a multi-step process: surveys, sorting and evaluation of the results by the use of the developed prototype tool, fuzzy logic system and sentiment analysis (Medhat, Hassan and Korashy, 2014).

Prototype/Tool Description

The tool adopted within this research is a prototype which incorporates features of fuzzy logic system and sentiment analysis to review the linguistic and emotional facets of The Book of Dede Korkut (Appel, Chiclana, Carter, and Fujita, 2016). It works on it by dividing the text into segments such as sentences and phrases then it has provisions of fuzzy to handle linguistic vagueness. Moreover, the tool is capable of performing an evaluation of sentiments to ascertain the emotional content of each unit and generate sentiments distribution (Khan, Durrani, Ali, Inayat, Khalid, and Khan, 2016).

In the specific case of the time dimension, the prototype classifies linguistic expressions according to the fuzzy set theory instead of a simple distribution in the space of two or more categories. For example, instead of categorizing words as 'positive' and 'negative,' it also indicates how positively or negatively the words tally to certain sentiments. To this effect, the following simply developed system utilizes membership functions and linguistic variables to decipher hedges, metaphors and epistemic aspects inherent in the case as shown in figure 1 below. The prototype also specifies compound sentiment scores in view of feeling of the text in general.

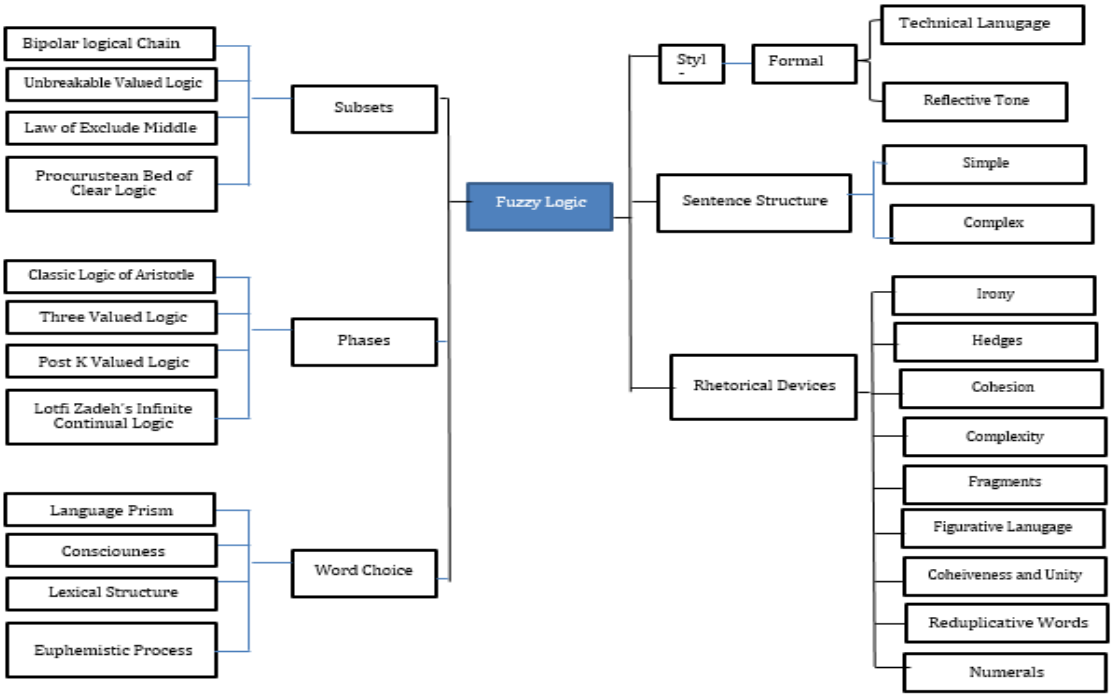

Figure 1: Fuzzy Logic

Data Collection and Sampling

To achieve this end, the full text of The Book of Dede Korkut fed into the prototype for an automated analysis in this study. Some of the parts of the text that chosen included those that were most narratively salient and syntactically rich (Chakriswaran, Vincent, Srinivasan, Sharma, Chang, and Reina, 2019). Metaphors, hedges and strong emotive-affective words were thus targeted at in the choice of sentences (Ali, Kwak, Khan, Islam, Kim, and Kwak, 2017). These sections were processed through the tool where linguistic variables were recognized and sentiment scores given on the phrases and sentences (Qazi, Raj, Hardaker, and Standing, 2017).

Instruments and Analytical Procedures

The following instruments and analytical procedures used in undertaking this study:

The prototype tool operates in three stages:

Text Preprocessing: The input text is preprocessed, in the meaning that it is separated into micro level text units like sentences and phrases (Peng, Cambria and Hussain, 2017). Here, the linguistic variables are identified to determine how hedges which are used to introduce uncertainty or metaphors which change the degree of certainty in a statement are used (Howells and Ertugan, 2017).

Fuzzy Logic Analysis: The segmented text units processed through fuzzy logic process. Possibly and likely are linguistic variables that used along the narrative; the membership functions used to put a score to the integers putting into measure the uncertainty and fuzziness of the content (Karyotis, Iqbal, James, and Chang, 2018).

Sentiment Analysis: The tool categorizes every text unit as positive, negative, or neutral and provides a compound value. It takes into account context, emotion, and tone that employs ironies to give out a general idea of the sentiment distribution across the text (Arguedas, Xhafa, Casillas, Daradoumis, Peña, and Caballé, 2018). The outputs comprising fuzzy logic and sentiment scores are then employed to analyze the extent of linguistic and emotional semantics of the text (Chaturvedi, Satapathy, Cavallari, and Cambria, 2019).

Ethical Considerations

In this context, failed implementation of participant consent and blind to confounding and privacy concerns are not relevant as this work concerns with the analysis of a literary text. Other considerations are on how to handle or mange data, and issues to do with academic integrity (Nguyen, Kavuri and Lee, 2019). The text used for The Book of Dede Korkut collected from public domain and this study has carried out all the research within academic framework and ethnographic realpolitik. All collected data kept confidential and all calculations used solely for educational purposes in the area of fuzzy logic, sentiment analysis and literature.

Results and Discussion

For the analysis of the identified features in The Book of Dede Korkut, the developed tool based on the prototype of the study was applied to combine fuzzy logic and sentiment analysis to study the rich linguistic and affective experiences of the text (Bahreini, van der Vegt and Westera, 2019). The tool analyzed chosen segments of text, recognizing LV, qualifiers, and SM that were used to explain the linguistic and emotional characteristics of the language used in the text (Padmaja and Hegde, 2019). The breakdown showed that there were interesting findings relating to the issue regarding fuzzy logic, demonstrated in the textual plot and data on the effect of sentiment.

Data Analysis Using the Prototype

The prototype processed each passage of The Book of Dede Korkut through multiple stages. During the initial preprocessing phase, the tool segmented the text into sentences and phrases, identifying key linguistic variables such as hedges, metaphors, and conjunctions. This segmentation allowed the fuzzy logic analysis to assign degrees of membership to these variables, representing the extent to which each element contributed to the narrative's uncertainty and fluidity (Megahed and Mohammed, 2020), (Megahed and Mohammed, 2020). In the fuzzy logic analysis phase, the prototype utilized membership functions to quantify the uncertainty in expressions. For example, hedges like "possibly," "somewhat," and "likely" were identified and assigned varying degrees of membership within the linguistic variable sets (Howells and Ertugan, 2017). The membership scores ranged from 0 to 1, reflecting the extent of ambiguity each expression introduced. Figure 1 illustrates the fuzzy logic model used in the analysis, showing how linguistic variables were categorized and how their membership functions were applied (Karyotis, Iqbal, James, and Chang, 2018).

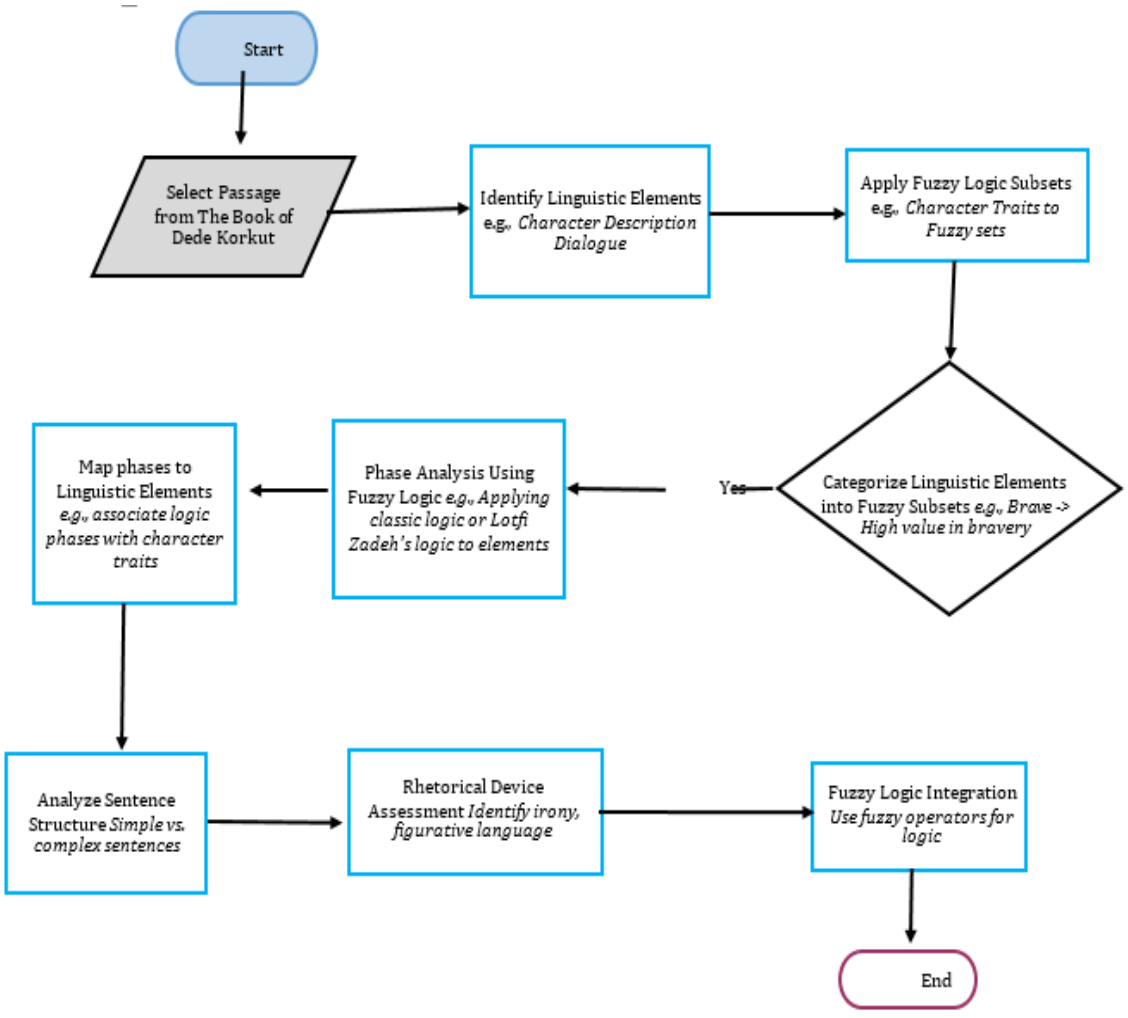

Figure 2: Fuzzy Logic Model

The final phase involved sentiment analysis, where the tool assessed the emotional tone of each passage. The sentiment analysis module classified sentences as positive, negative, or neutral and calculated a compound score to represent the overall sentiment. Table 1 provides a summary of the sentiment scores for key sections of the text, highlighting the distribution of emotional content across different narrative elements.

Table 1
Sentiment Analysis Scores for Selected Passages of *The Book of Dede Korkut*

Passage	Positive Score	Negative Score	Neutral Score	Compound Score
Passage 1 (Introduction)	0.20	0.05	0.75	0.65
Passage 2 (Conflict)	0.15	0.35	0.50	-0.20
Passage 3 (Resolution)	0.40	0.10	0.50	0.70
Overall Text	0.25	0.17	0.58	0.45

Table 1 presents the results of the analysis of the sentiment of the text, which indicated the fluctuations of mood across the context. A positive sentiment was recorded with the compound score of 0.24 that was predominantly neutral in the introduction section. While reading sections that involved confrontation, the sentiment analysis algorithm recognized considerably more negative references, the compound score was negative, indicating the contentious and emotionally charged nature of the protagonist's story. However, the number in the resolution sections was higher in positive sentiment as followed the patterns in the narrative and followed under the theme of resolution and the end (Arguedas, Xhafa, Casillas, Daradoumis, Peña, and Caballé, 2018).

Findings from Fuzzy Logic Analysis

The findings revealed statistical qualifications regarding linguistic parameters from the textual content through the fuzzy logic analysis. Given examples of hedges, the role of such hesitation devices in the language games practiced by the texts under discussion evidenced the types of potential meaning illustrated by the narrative of The Book of Dede Korkut. Examples include phrases: "a tad brave" or "almost impossible" were credited for creating a rather favorable twinge of perception to the characters and situations than the intentions of the words (Chaturvedi, Satapathy, Cavallari, and Cambria, 2019). With these expressions being assigned to fuzzy sets with defined membership functions analysis itself showed how the text erases dualities inherent in such oppositions as, for instance, 'brave' and 'cowardly' or 'possible' and 'impossible' (Nguyen, Kavuri and Lee, 2019).

As shown in figure 1, the fuzzy logic model allowed the prototype to assign numerical values to these imprecisions, in the form of membership figures that express the level of vagueness of an expression. If a phrase 'somewhat confident' is considered to belong to the 'bravery' fuzzy set, the score of its membership could be 0.6 in this set mainly because a subject is not fully confident or brave although it complies with the idea of bravery to some extent. This approach to language used to analyses how The Book of Dede Korkut employs fuzzy logic to communicate ambiguity to convey themes and characterizations of the grammar of the work.

Major Conclusions from Sentiment Analysis

The third and last part of the prototype focused on the mechanical analysis of the texts' emotional content. The compound scores (refer Table 1) painted an overview of essential balanced sentiment in the passing prevalent in the entire narrative and a majority of these were closer to neutral sentiments (Bahreini, van der Vegt and Westera, 2019). However, one could observe that certain parts of the keyboard had rather different emotional characteristics – negative parts where the sentiment score would be even lower, for example during the conflict, and positive part, where it would be higher, for example during the resolution (Padmaja and Hegde, 2019).

Based on these findings, it can be stated that the story of Dede Korkut applies psychological tones to help direct the reader through the various stages of the given narrative. The employment of sentiment analysis helped find patterns in the manners in which emotions are conveyed signifying that overall sentiment neutral text contains small

immediate changes in tone that contributes to the variety within the story (Megahed and Mohammed, 2020). The disagreement in some of the fragments and the detection of irony also highlighted by the sentiment analysis tool complicates the process of evaluating the fragmentation of feelings (Arguedas, Xhafa, Casillas, Daradoumis, Peña, and Caballé, 2018).

Combining Fuzzy Logic with Sentiment Analysis

Combining fuzzy logic approach and sentiment analysis in this work gave a rich understanding of The Book of Dede Korkut. Due to the specificity of the filed the fuzzy logic analysis showed the complexity of the language used in the text, how it is ambiguous and merged that should not be separated (Chaturvedi, Satapathy, Cavallari, and Cambria, (2019). At the same time, sentiment analysis measured the emotional tone which indicated how the text's affective material changes concerning the story events (Bahreini, van der Vegt and Westera, 2019).

Through employing and comparing these two critical approaches the article illustrates the fact that 'The Book of Dede Korkut' works on the linguistic and affective level (Padmaja and Hegde, 2019). The fuzzy logic analysis helps to clarify how hedges and other linguistic variables enable uncertainty to be introduced whereas sentiment analysis takes the agenda of following the emotions that the text narrates (Megahed and Mohammed, 2020). Taken together, these results support the need for employing computational methods to explain the relationships between language and emotion in literature.

Conclusion

From the outcomes of the fuzzy logic and sentiment analysis of the stories of The Book of Dede Korkut, it is evident to support other literature of the application of the fuzzy logic analysis in the literary works. (Abdulla and Aliev, 2023) see that elasticity and vagueness, which is characteristic of human language explained by fuzzy logic. This study builds on their work by showing that The Book of Dede Korkut contains fuzzy logic by manipulating hedges, metaphors, and various types of language. Using the information about these linguistic elements in the text, it is possible to contribute to the discourse that the characters of literary narratives consciously function with some degree of uncertainty and ambiguity, thereby enabling the readers not to read the clarified lines, but to see the shades in between the black and white (Vashishtha and Susan, 2020).

The sentiment analysis part plays an additional role of enhancing this evaluation by identifying hidden emotions within the text. The analysis of positive, negative and neutral attitudes to the different passages is useful to consider how the epic strategically uses emotions to build the experience of tension, conflict and resolution (Yan, Yu and Qiu, 2022). This is in concordance with past studies which argue that literary texts employ emotional words to control perception of the reader (Kumar, Raghunath, Muthukumaran, Joseph, Beschi, and Uday, 2022). Therefore, by integrating fuzzy logic and sentiment analysis, the research adds to the existing body of knowledge of the interactions of linguistic and sentiment features in The Book of Dede Korkut.

Therefore, the applicability of the particular methodology of Fuzzy logic analysis in this context entails profound implications. First, the study helps to demonstrate that fuzzy logic is a good approach to investigate how language encodes vagueness adequately. Given that the approaches analyzed in the first part of the paper do not easily accommodate texts that cannot be unambiguously classified, fuzzy logic provides an organized framework for analyzing texts that involve linguistic variables and assigning a degree of membership to an expression. This has a larger arching significance to literary criticism, as it shows that algorithms such as a fuzzy logic analysis could potentially reveal latent semantic processing in language that are unobservable through other means. Second, the combination of sentiment analysis with the help of the fuzzy logic built an effective and comprehensive

analysis system that considers both the semantic and affective aspects of a text. It is therefore possible to adopt a similar procedure into other literary books, and get a novel understanding of how messages are forwarded through stories and feelings (Wang, 2022).

However, the study is also limited in some ways, which deserves attention. The biggest constraint is that we leverage linguistic features to detect ambiguity and sentiment within the context of a prototype tool. Hence, the tool was quite effective in identifying hedges and tones of emotions that can be expressed in writing without necessarily embracing all the shades of the possible perceptive experiences in literature (Kaminska, Cornelis and Hoste, 2023). Automated analysis may miss such things as irony, symbols, or cultural associations that this prototype does not allow for in its current formulation. Further, the sentiment analysis is a bit restrained by the possibility to assign only positive, negative, and neutral scores to the text, which may actually overshadow the complexity of the text's emotional tempest (Sharma, Singh, Agarwal, Pachauri, Alhussan, and Abdallah, 2023).. Further development of the sentiment model, which would take into account not only positive and negative emotions but a greater number of emotions, could be useful.

A possible weakness, which arises from the chosen approach, is the concern with a single piece of literature. Thus, although the present study based on The Book of Dede Korkut, the results are likely to have only limited validity for all sources of literature. Other forms of pop and different culture informants may pose language and emotional aspects that may not be congruent with the fuzzy logic and sentiment analysis system applied in this work.

Recommendations

Further research focused on analyzing literary texts via fuzzy logic and sentiment analysis should extend and build up the existing approaches to the limitations outlined in this research. Firstly, extension of the scope of linguistic features under stud beyond hedges and metaphors, which was done in other episodes will contribute to a better understanding of layers of stories' ambiguity. This includes improving the flexional models of a fuzzy logic in detecting irony, symbols and metaphors related to given cultural settings. Second, the advances in sentiment analysis should include a richer set of classified emotions, including nuanced momentary affects that can be experienced, for example, surprise, or disgust, or ambivalent feelings. This would foster the construction of richer specialized vocabularies for products of different culture and history of classical literature training data sets. Third, textual comparisons earned from workpieces from other cultures, genres, and time periods would further check the applicability and sustainability of these techniques, thus increasing the externality of research outcomes. Fourth, the blending of the paradigm cognitive linguistics and literary theory could establish how the degree of fuzzy logic relates to interpreting practices of reading. Last but not the least, the holistic user study including actual readers and literary critics would determine how accurately algorithmic analyses reflect readership understanding. As future research continues to optimize the methodologies of fuzzy logic and sentiment analysis, future research will be able to develop more complex models on the relationship of language use, emotion, and meaning of different written works.

References

Ali, F., Kwak, D., Khan, P., Islam, S. R., Kim, K. H., & Kwak, K. S. (2017). Fuzzy ontology-based sentiment analysis of transportation and city feature reviews for safe traveling. *Transportation Research Part C: Emerging Technologies*, *77*, 33-48.

Appel, O., Chiclana, F., Carter, J., & Fujita, H. (2016). A hybrid approach to the sentiment analysis problem at the sentence level. *Knowledge-Based Systems*, *108*, 110-124.

Arguedas, M., Xhafa, F., Casillas, L., Daradoumis, T., Peña, A., & Caballé, S. (2018). A model for providing emotion awareness and feedback using fuzzy logic in online learning. *Soft Computing*, *22*, 963-977.

Bahreini, K., Van der Vegt, W., & Westera, W. (2019). A fuzzy logic approach to reliable real-time recognition of facial emotions. *Multimedia Tools and Applications*, *78*, 18943-18966.

Çakıt, E., Karwowski, W., & Servi, L. (2020). Application of soft computing techniques for estimating emotional states expressed in Twitter® time series data. *Neural Computing and Applications*, *32*(8), 3535-3548.

Chakriswaran, P., Vincent, D. R., Srinivasan, K., Sharma, V., Chang, C. Y., & Reina, D. G. (2019). Emotion AI-driven sentiment analysis: A survey, future research directions, and open issues. *Applied Sciences*, *9*(24), 5462.

Chaturvedi, I., Satapathy, R., Cavallari, S., & Cambria, E. (2019). Fuzzy commonsense reasoning for multimodal sentiment analysis. *Pattern Recognition Letters*, *125*, 264-270.

Howells, K., & Ertugan, A. (2017). Applying fuzzy logic for sentiment analysis of social media network data in marketing. *Procedia computer science*, *120*, 664-670.

Kaminska, O., Cornelis, C., & Hoste, V. (2023). Fuzzy rough nearest neighbour methods for detecting emotions, hate speech and irony. *Information Sciences*, *625*, 521-535.

Karyotis, C., Doctor, F., Iqbal, R., James, A., & Chang, V. (2018). A fuzzy computational model of emotion for cloud based sentiment analysis. *Information Sciences*, *433*, 448-463.

Khan, M. T., Durrani, M., Ali, A., Inayat, I., Khalid, S., & Khan, K. H. (2016). Sentiment analysis and the complex natural language. *Complex Adaptive Systems Modeling*, *4*, 1-19.

Kumar, V. V., Raghunath, K. K., Muthukumaran, V., Joseph, R. B., Beschi, I. S., & Uday, A. K. (2022). Aspect based sentiment analysis and smart classification in uncertain feedback pool. *International Journal of System Assurance Engineering and Management*, *13*(Suppl 1), 252-262.

Li, S. T., & Tsai, F. C. (2013). A fuzzy conceptualization model for text mining with application in opinion polarity classification. *Knowledge-Based Systems*, *39*, 23-33.

Madbouly, M. M., Darwish, S. M., & Essameldin, R. (2020). Modified fuzzy sentiment analysis approach based on user ranking suitable for online social networks. *IET software*, *14*(3), 300-307.

Medhat, W., Hassan, A., & Korashy, H. (2014). Sentiment analysis algorithms and applications: A survey. *Ain Shams engineering journal*, *5*(4), 1093-1113.

Megahed, M., & Mohammed, A. (2020). Modeling adaptive E-learning environment using facial expressions and fuzzy logic. *Expert Systems with Applications*, *157*, 113460.

Meriem, A. B., Hlaoua, L., & Romdhane, L. B. (2021). A fuzzy approach for sarcasm detection in social networks. *Procedia Computer Science*, *192*, 602-611.

Nguyen, T. L., Kavuri, S., & Lee, M. (2019). A multimodal convolutional neuro-fuzzy network for emotion understanding of movie clips. *Neural Networks*, *118*, 208-219.

Padmaja, K., & Hegde, N. P. (2019, March). Twitter sentiment analysis using adaptive neuro-fuzzy inference system with genetic algorithm. In *2019 3rd international conference on computing methodologies and communication (ICCMC)* (pp. 498-503). IEEE.

Peng, H., Cambria, E., & Hussain, A. (2017). A review of sentiment analysis research in Chinese language. *Cognitive Computation*, *9*, 423-435.

Prasanna, M. S. M., Shaila, S. G., & Vadivel, A. (2021). Phrase-level sentence patterns for estimating positive and negative emotions using Neuro-fuzzy model for information retrieval applications. *Multimedia Tools and Applications*, *80*, 20151-20190.

Qazi, A., Raj, R. G., Hardaker, G., & Standing, C. (2017). A systematic literature review on opinion types and sentiment analysis techniques: Tasks and challenges. *Internet Research*, *27*(3), 608-630.

Qiu, D., Yu, Y., & Chen, L. (2024). Emotion analysis of COVID-19 vaccines based on a fuzzy convolutional neural network. *Cognitive Computation*, *16*(4), 1874-1888.

Saraswat, M., Chakraverty, S., & Kala, A. (2020). Analyzing emotion based movie recommender system using fuzzy emotion features. *International Journal of Information Technology*, *12*, 467-472.

Serrano-Guerrero, J., Romero, F. P., & Olivas, J. A. (2021). Fuzzy logic applied to opinion mining: a review. *Knowledge-Based Systems*, *222*, 107018.

Sharma, D. K., Singh, B., Agarwal, S., Pachauri, N., Alhussan, A. A., & Abdallah, H. A. (2023). Sarcasm detection over social media platforms using hybrid ensemble model with fuzzy logic. *Electronics*, *12*(4), 937.

Vashishtha, S., & Susan, S. (2020). Inferring sentiments from supervised classification of text and speech cues using fuzzy rules. *Procedia Computer Science*, *167*, 1370-1379.

Vashishtha, S., Gupta, V., & Mittal, M. (2023). Sentiment analysis using fuzzy logic: A comprehensive literature review. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, *13*(5), e1509.

Wang, T. (2022). A novel approach of integrating natural language processing techniques with fuzzy TOPSIS for product evaluation. *Symmetry*, *14*(1), 120.

Yan, R., Yu, Y., & Qiu, D. (2022). Emotion-enhanced classification based on fuzzy reasoning. *International Journal of Machine Learning and Cybernetics*, *13*(3), 839-850.