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Semantic Fantepedia System: Development and Usability Evaluation

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ABSTRACT

Even though the Fante language is widely spoken in Ghana, especially in Central and Western Regions, there is still a lack of comprehensive and user-friendly resources for accessing and disseminating Fante knowledge. Existing Fante encyclopaedias have limited coverage, outdated information, and poor usability. Therefore, there is a pressing need for a comprehensive system that overcomes these limitations and provides a user-friendly platform for accessing and contributing to Fante knowledge. The objective of this research is to develop and evaluate the Semantic Fantepedia System that will aid in organizing and preserving the knowledge and culture of the Fante people of Ghana. The Design Science Research Methodology (DSRM) model was used in the development process to ensure a structured, efficient, and quality-driven approach to Semantic Fantepedia system development, enhancing project management and user satisfaction. Also, the usability evaluation of the Semantic Fantepedia System (SFS) was carried out using the System Usability Scale (SUS) which also produced positive results. The mean SUS score of 83.2 indicates that the participants generally rated the system's usability as scoring grade A, excellent and acceptable. This high score demonstrates positive user experiences, showing that the system is considered easy to use and successful in achieving its intended objectives. Only 10% of participants considered the system's usability as marginal, indicating potential areas for improvement. Importantly, none of the participants rated the system as poor, confirming that even the lowest scores suggest at least moderate usability. Based on these findings, our recommendations include expanding the knowledge base to cover more topics, implementing advanced natural language processing for improved search accuracy, adding multilingual support, and ensuring regular content updates. Future work will focus on these recommendations, exploring machine learning for automated content enrichment and data validation, as well as developing a mobile application to enhance accessibility and multilingual support.

1. Introduction

Ghana is a multilingual country of which Fante is one of the languages mostly spoken in the Central and Western Regions. It is considered part of the Akan language variety, along with Ahanta,

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Akuapem, and Asante, and has languages such as Agona, Anomabo, Abura, and Gomoa. It is also known as Fantse or Mfantse, and it is spoken by approximately 6 million people in Ghana (as of 2020–2025) according to Wikipedia contributors (n.d.) Fante dialect, retrieved September 9, 2025.

Despite the large number of people speaking the language, the inadequacy of electronic materials and encyclopedias has limited the opportunities for non Fante speakers especially foreigners to learn the language. Presently, education in Ghana is divided into six years of elementary education and three years of junior secondary education (jointly referred to as basic education), followed by three years of senior secondary education and then, a standard four-year university program[1]. Fante should have been the dominant language to be taught at the basic school levels in the Fante communities, however, this is met with a challenge [2]. The English language, which is not the native language of these students are instead used in lesson delivery in these communities. Researches have shown that the Fante language lacks adequate digital resources for preserving and disseminating Fante knowledge and culture[3]. Existing Fante knowledge is largely in the form of traditional texts, documents, and oral traditions, which are difficult to access and share digitally[4]. These poses challenges on how to preserve Fante culture and knowledge from irreversible loss, provide Fante speakers with an accessible repository of Fante knowledge and digitize and formalize traditionally "informal" Fante knowledge[5]. To address these issues, this research aims to develop and evaluate a Semantic Fantepedia System that will aid in organizing, digitalizing, preserving, and promoting Fante knowledge and culture. Therefore, this research would help fill this gap and contribute to the development and evaluation of Fante digital educational platforms that would promote the learning and speaking the Fante indigenous languages in Ghana[6].

In line with this, this paper is organised as follows; this study begins with a background section that introduces the research problem, emphasizing the lack of adequate digital tools for preserving and disseminating indigenous knowledge, particularly within the Fante context, and frames the research questions and objectives[7]. The literature review synthesizes existing scholars on cultural heritage systems and semantic technologies, highlighting important contributions such as Mukurtu for community-driven knowledge management[8] and HERITRACE for semantic data editing[9] while also identifying gaps in providing culturally grounded, language-specific repositories. A design science research methodology [10] underpins the system development, with details on participants, tools, technologies,[11] and ethical considerations such as cultural sensitivity and data privacy.

Findings are presented through statistical analyses, tables; and figures. The discussion situates these findings within the broader field, acknowledging limitations such as sample size and scalability, while suggesting directions for future work in semantic interoperability and user-centred cultural preservation platforms [12].

In a nutshell, this research would help in promoting cultural diversity, improving access to quality education and filling research gaps in Ghanaian education. The study concludes by reiterating its contributions to both cultural heritage preservation and digital humanities, underscoring the relevance of the Semantic Fantepedia System in addressing the urgent need for safeguarding indigenous knowledge in the digital era. The research questions to be answered in this study are: 1) What key features and functionalities should the Semantic Fantepedia System have? 2) How will the Semantic Fantepedia System prototype be designed with the core concepts and architecture based on the identified features and functionalities? 3) How will the Semantic Fantepedia System be developed based on the system design? 4) How will the Semantic Fantepedia System be evaluated using the usability and user experience through user studies?

2. Methodology

The overall project would be guided by the Design Science Research Methodology (DSRM) model for systematic design, experimentation, and evaluation.

2.1 Overall Research Flow

The overall research flow shown in Figure 1 below depicts the processes involved in the Design Science Research Methodology (DSRM) model.

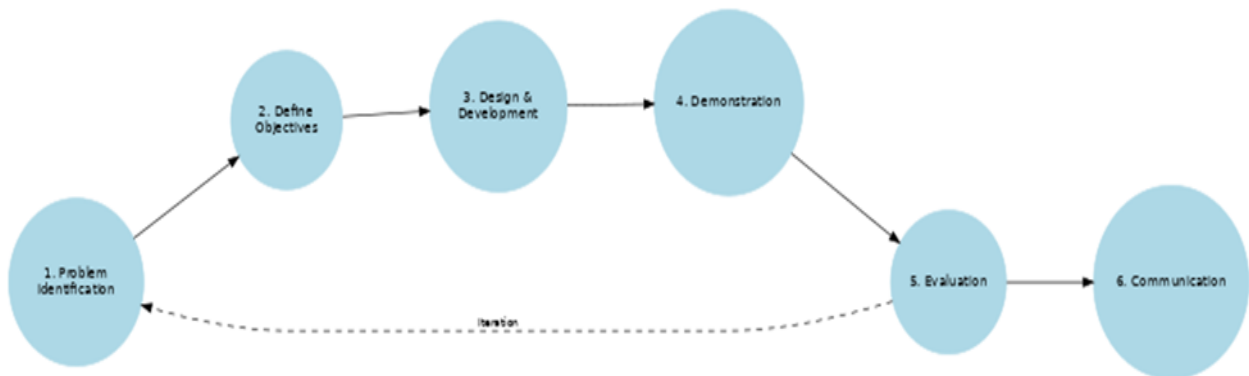


Fig. 1.The Overall Research Flow

The Design Science Research Methodology (DSRM) model follows six key phases as shown in figure 1 above. It begins with problem identification, where the research issue is defined, followed by defining objectives to set clear goals[10] In design and development, prototypes or models are created to address the problem. These are tested in the demonstration phase, after which the system undergoes evaluation to assess its effectiveness and usability[12]. Finally, the communication phase disseminates the findings to both academic and professional audiences. This iterative process, widely applied in digital heritage studies, [10] ensures rigor and relevance in developing systems like the Semantic Fantepedia.

2.1.1 Data flow diagram

The Data Flow Diagram shown in figure 2(a) below was used in data definition, especially in defining the system's entities and how they interacted with each other. The design approach provided the actors and used case descriptions and diagrams to explain the roles each plays to accomplish the system design objectives.

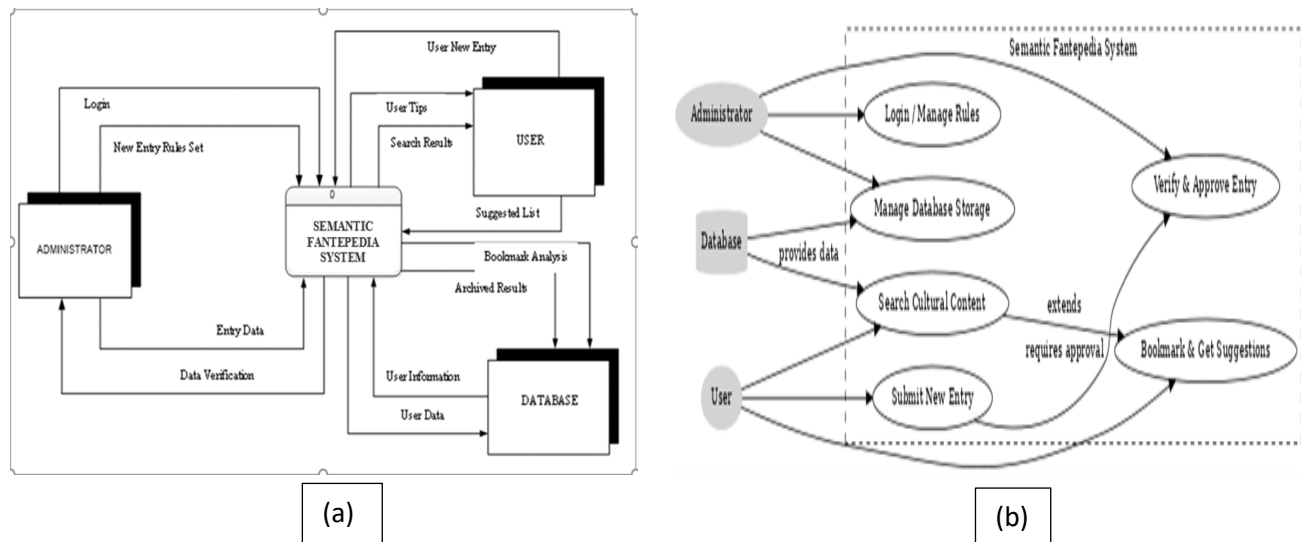


Fig. 2. Data Flow Diagram

Figures 2(b) illustrated three key actors within the system: the administrator, the database, and the user. The administrator accesses the system to input new entries and maintain the history and dictionary. Before updating the database, the administrator assesses the inputs and contributions made by the user for accuracy. The database stores the information provided by the administrator, documents bookmark analyses, and replies to user inquiries. Meanwhile, the user searches for information and also contributes data to the system, which requires verification and validation. The following are the actors of the application: Database, Administrator and User. All actors shall view a home page. All roles are clearly presented in Table 1.

Table 1
Actors Role

Actor	Use Case	Description
End-user	Opens user interface	The user clicks on the preferred button on the dashboard to open
	User tips and a suggested list	The user learns the tips of the system to improve his/her knowledge. Moreover, suggested lists pop up if the search is executed.
	New data entry	Users are enabled to input new data for verification
	Bookmark Analysis	The system keeps recently viewed data for users
	Run search input	The system executes the input data by the user for results
Database	Archive information	Saves every information about the system for end-user utilization
	User information	Data of the user is stored for easy recognition
	Set system rule	The rules for the system usage are for users
	New entry	The administrator adds new data to the system
	View user data entry	Verifies user data input before adding it
Administrator	Login	Login to access the system and update it if necessary

3. Results and Discussions

The results of the study are provided below in the form of background characteristics of participants, user interfaces, functionalities and usability test results. The results are presented and discussed using subheadings to support the overall objectives of the system.

3.1 The Semantic Fantepedia System

The Semantic Fantepedia System is open to all language enthusiasts and researchers who want to learn about Fante cultures. It is a web-based system that can be accessed from any location and at any time on the Internet. The administrator is responsible for imputing data for dictionary usage and provides historical and cultural fact information. Furthermore, the administrator enables users to contribute to cultural and historical facts and authenticate the entered information, as well as grant access to readers.

Figure 3 shows the homepage of the Fantepedia System with navigational links to other resources. From the homepage users can access information about the Fante alphabet and word formation, as well as details about various Fante ethnic groups and their origins, including the intriguing facts surrounding their existence. In addition, users are provided with resources from the Fante dictionary, language tutorials, pronunciation of Fante terms, and Fante Relics. Furthermore, an automated virtual museum is linked to the system, enabling users to explore facts about Fante land. Apart from browsing and exploration, users can add contents and it will first be validated by administrator before saving into the database.



Fig. 3. Home Page

3.2 Demographic Characteristics of Participants

3.2.1 Age and gender distribution of participants

Figure 4 illustrates the age distribution of the 50 participants. The largest group, comprising 48% of participants, fell within the 18-24 age range. This is followed by 20% participants within the 25-34 age range. The remaining participants fell within the age groups, under 18(%), 35-44(%), 45-54(%), 55-64(%), and 65 or older (%). Also, 44% of the participants indicated that they were male, while 56% indicated that they were female as demonstrated in Figure 5.

A. What is your age?
50 responses

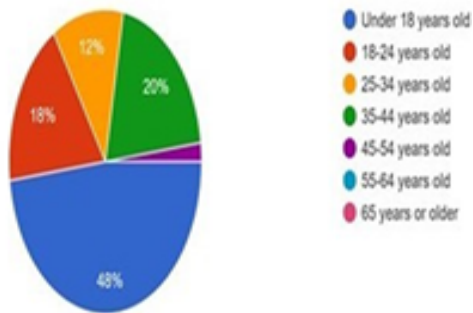


Fig. 4. Age Distribution

B. What is your gender?
50 responses

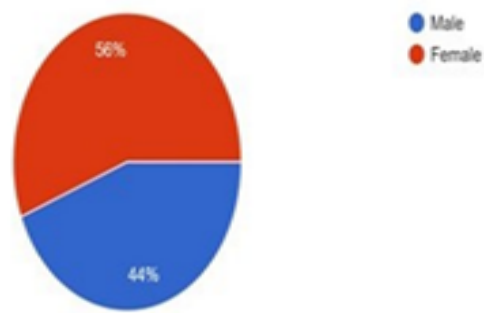


Fig. 5. Gender distribution

3.2.2 Educational background distribution of participants

Figure 6 presents the distribution of participants' educational levels of 50 participants. The largest portion, 40%, have completed high school or an equivalent qualification. This is followed by 26% who have a junior high education, and 18% who hold a bachelor's degree. Lastly, 16% of respondents have attained a master's degree. Notably, there are no responses recorded for primary education, doctorate or higher, or the "Other" category, as these segments are absent from the chart.

E. What is your highest educational level?
50 responses

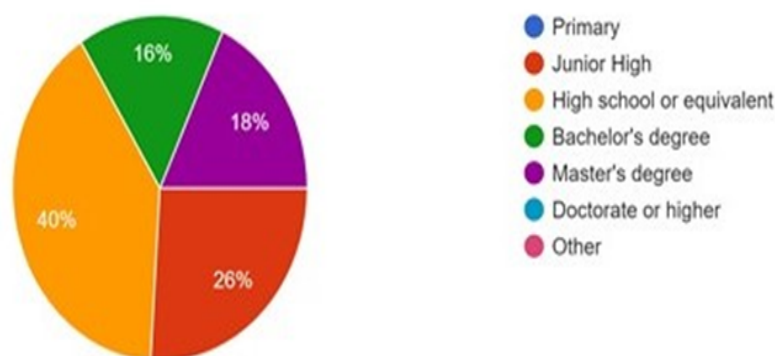


Fig. 5. Educational Level

3.2. 3 Ethnicity distribution of participants

Figure 7 displays a bar chart illustrating the distribution of ethnicities among the 50 participants. The largest group, identified by 78% of participants, were Akans. Followed by Hausa, Ewes and Nzema that recorded 6% respectively. Ga recorded 4%. The remaining are Bono and Others of the participants with each contributing 2% of the participants.

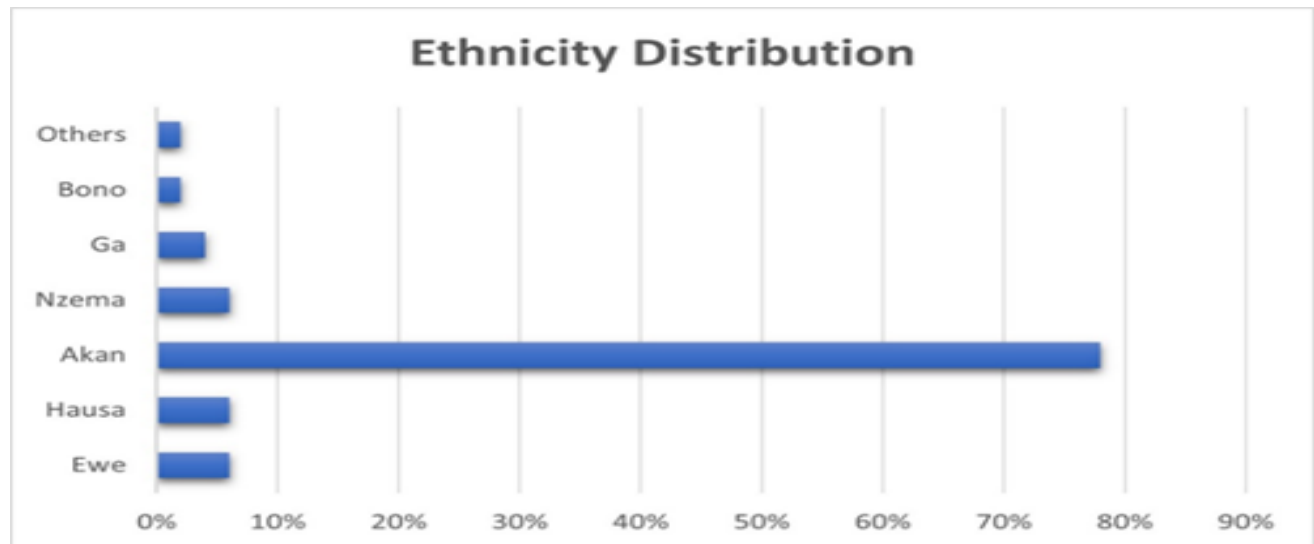


Fig. 6. Ethnicity Distribution

3.3 Usability Evaluation Results

Drawing from the work of[13] the research work adopted a 3-level usability evaluation framework to delve deeply into the interactions among the user, task, system, and environment. The iterative refinement of system content, features, functionalities, and interface were driven by the insights gleaned from the 3-level usability evaluation, with a focus on meeting the needs of our target end-users. During the SUS evaluation, participants were first tasked to explore and interact with the Fantepedia system. Immediately after that they were tasked with evaluating the system by completing a SUS questionnaires comprising 10 statements, each utilizing a 5-point Likert scale. The 5-point Likert scale incorporates the following options: (1) Strongly Disagree; (2) Disagree; (3) Neither Agree nor Disagree; (4) Agree; (5) Strongly Agree. The SUS statements, are detailed in Table 2 below.

Table 2

SUS Statement

No	SUS Statements
1.	I think I will use this system often
2.	I found the system unnecessarily complicated
3.	I think this system is easy to use
4.	I think I need support from a technical person to be able to use this system
5.	I found the various functions in this system to be well integrated
6.	I think there are a lot of inconsistencies in this system
7.	I imagine that most people will learn to use this system quickly.
8.	I found this system very complicated to use
9.	I feel very confident in using this system.
10.	I need to learn a lot of things before I can use this system.

The research analysis was carried out based on SUS score calculations by utilizing data from the SUS survey. Several findings from the score validation method are presented in the sub-headings below.

3.3.1 SUS Score measurement

After users' interaction with the system, the System Usability Scale (SUS) questionnaires were administered to the 50 participants through Google forms application. Table 3 below displays the data and the SUS score calculation. The top score of 4.6 out of 5 was achieved in Q2, Q4, Q7, and Q9. Conversely, the lowest score, 3 out of 5, was recorded in Q1. It is important to note that all statements are positive, so the highest score represents the best result, while the lowest score indicates the least favourable outcome.

Table 3
SUS Scores Measurement

Participants	Q 1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS Score
Participant 1	5	4	5	3	5	2	5	2	5	1	82.5
Participant 2	4	2	4	2	4	2	4	2	4	2	75
Participant 3	3	2	4	2	4	2	4	2	5	4	70
Participant 4	4	4	4	2	5	2	4	2	4	4	67.5
Participant 5	5	1	4	1	5	2	4	1	5	1	92.5
Participant 6	5	1	5	1	5	1	5	1	5	1	100
Participant 7	5	1	5	1	5	1	5	1	5	1	100
Participant 8	4	2	4	4	4	2	5	4	5	4	65
Participant 9	5	3	3	5	4	2	2	3	4	5	50
Participant 10	4	4	5	2	5	1	5	2	4	2	80
Participant 11	5	2	4	2	5	2	5	1	5	2	87.5
Participant 12	4	1	4	2	5	1	5	1	5	2	90
Participant 13	5	1	5	2	5	1	5	1	5	1	97.5
Participant 14	5	1	5	2	5	1	5	1	5	2	95
Participant 15	5	2	4	2	5	2	5	1	5	2	87.5
Participant 16	5	1	5	2	5	1	5	1	5	2	95
Participant 17	5	1	5	2	5	2	5	1	5	2	92.5
Participant 18	4	2	4	4	5	2	4	2	4	2	72.5
Participant 19	5	1	4	2	5	2	5	2	5	2	87.5
Participant 20	5	2	4	2	5	2	5	1	5	2	87.5
Participant 21	5	2	5	2	5	2	5	2	5	2	87.5
Participant 22	4	2	4	2	4	2	4	2	5	2	77.5
Participant 23	5	2	5	2	5	2	5	2	5	2	87.5
Participant 24	5	2	5	2	5	2	5	2	5	2	87.5
Participant 25	5	2	5	3	5	2	5	2	5	3	82.5
Participant 26	5	2	5	2	5	2	5	2	5	2	87.5
Participant 27	5	2	5	2	5	2	5	2	5	2	87.5
Participant 28	5	2	4	2	5	3	4	2	5	2	80
Participant 29	5	2	5	2	5	2	5	2	5	2	87.5
Participant 30	5	2	5	2	5	2	5	2	5	2	87.5
Participant 31	4	2	5	2	5	2	5	2	5	2	85
Participant 32	4	3	4	4	4	3	4	2	5	3	65
Participant 33	5	2	4	2	5	2	4	2	5	1	85
Participant 34	5	2	4	2	5	2	5	2	5	2	85
Participant 35	5	2	5	2	5	2	5	2	5	2	87.5

Participant 36	5	2	4	3	5	2	4	2	5	2	80
Participant 37	4	4	2	4	4	3	4	2	4	2	57.5
Participant 38	5	2	5	2	5	2	5	2	5	2	87.5
Participant 39	5	2	5	2	5	2	5	2	5	2	87.5
Participant 40	5	2	5	2	5	2	5	2	5	2	87.5
Participant 41	5	2	5	2	5	2	5	2	5	2	87.5
Participant 42	5	2	5	2	5	2	5	2	5	3	85
Participant 43	5	1	4	3	5	3	4	2	4	3	75
Participant 44	4	2	5	2	5	1	5	2	5	2	87.5
Participant 45	4	3	4	4	4	3	4	2	4	4	60
Participant 46	5	2	5	2	5	2	5	2	5	2	87.5
Participant 47	5	2	4	4	5	2	5	2	5	3	77.5
Participant 48	5	3	4	3	5	3	4	2	5	3	72.5
Participant 49	5	3	5	4	5	3	5	2	5	4	72.5
Participant 50	5	2	5	2	5	2	5	2	5	2	87.5

3.3.2 System Usability Scale results

System Usability Scale was used for evaluating subjective usability, providing a score ranging from 0 to 100, where higher scores indicate better usability. The raw score is derived from participant responses to 10 System Usability Scale questionnaires containing alternating positive and negative statements, and is then transformed into a final score on a 100-point scale.

A summative evaluation was carried out to assess the Semantic Fantepedia System's user experience and "usability through user studies as approved by [14]. The evaluation techniques employed included user participation and inquiry techniques. With regards to user participation, both field studies and laboratory tests were conducted in five schools namely; Aggrey Memorial AME Zion Senior High (10 participants), AME Zion Basic School (10 participants), Jubilee Basic School (10 participants), Moree Community School (10 participants) and the Oguua Senior Technical School (10 participants) all in Cape Coast Metropolis. After users' interaction with the system, questionnaires were administered to the 50 participants through Google forms application.

3.3.3 Descriptive statistics of SUS scores

After examining the data, the SUS scores varied from 50 as the lowest to 100 as the highest, indicating diverse opinions on the system's usability among the participants. Below in Table 4, presents a summary of the important descriptive statistics, such as the average score, standard deviation, and the breakdown of scores within usability categories.

Table 4

Descriptive Statistics of SUS Score

Statistic	Value
Number of Participants	50
Minimum SUS Score	50
Maximum SUS Score	100
Mean SUS Score	83.2
Standard Deviation	10.6

The descriptive statistics of the System Usability Scale (SUS) presented in Table 5 above indicated a mean score of 83.2, with a standard deviation of 10.6, a minimum score of 50, and a maximum score of 100. According to established SUS benchmarks, scores above 80 are classified as "excellent," reflecting high user satisfaction and positive perceptions of usability.

The final SUS scores were used to classify the system's usability into four levels: Poor (below 50), Marginal (50-69), Good (70-84), and Excellent (85-100). Majority of the 50 participants (50%) gave the system an excellent usability rating, while 40% rated it as good. Only 10% of participants considered the system's usability as marginal, indicating potential areas for improvement. Importantly, none of the participants rated the system as poor, confirming that even the lowest scores suggest at least moderate usability. Participants gave high ratings for ease of use and confidence, with mean scores of 4.8 and 4.9 respectively. These results suggest that the system is perceived as intuitive and simple, offering a satisfying user experience. However, responses to negatively worded items (e.g., Q2, Q4, Q6) revealed some mild concerns, with mean scores of 2.1 to 2.0 in areas such as complexity and the need for additional support. No participant rated the system's usability below 50, indicating that the system avoids critical usability issues that could hinder task completion or significantly frustrate users.

4. Conclusions

The Semantic Fantepedia System will greatly benefit Fante language enthusiasts including students and tourists very much. Students can use the system to undertake research work on Fante history and culture. The system will provide ready information in text and motion graphics for students to access facts in a variety of media. The contents presented on the system allowed users to control the media using designated control features present on the system. This helps users to access the information at their own access pace. There are links and hypermedia that enable users to outsource more information about a particular content on web resources. There is a rising demand for a common platform for language fact presentation which employs various multimedia forms to present information to users.

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