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Development of an Animated *Yorùbá* Language Learning System

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Abstract. This study presents the development and evaluation of an animated language learning system designed to support the teaching and acquisition of the *Yorùbá* language using culturally grounded 3D animation. The system integrates curriculum-based content with traditional settings, audio-visual elements, and interactive storytelling to enhance engagement and comprehension among learners. Blender was employed to model characters, environments, and animations, while Mixamo was used for rigging and motion capture. Texturing, lighting, audio synchronization, and rendering were executed to reflect authentic cultural expressions and pronunciation accuracy, guided by consultations with native speakers. To evaluate the system, user testing was conducted with 15 participants using a structured questionnaire analysed through the Mean Opinion Score (MOS) method across five key parameters: usability (96.20%), accuracy (98.60%), timeliness (97.40%), user-friendliness (95.00%), and responsiveness (95.20%). The high scores across all parameters suggest the system is effective, easy to use, and pedagogically sound. The findings affirm that animation-based instruction can significantly enhance indigenous language learning, offering a sustainable approach to language preservation and revitalization in the digital age.

Keywords: Yorùbá language learning; indigenous language preservation; culturally responsive education; interactive multimedia; Blender; Mean Opinion Score (MOS).

1. Introduction

One of the most widely spoken native languages in West Africa, especially in Nigeria is *Yorùbá*. There is a decrease in its active usage among younger generations because of the prevalence of English in education and media, globalization and urbanization. This has raised concerns about language endangerment and the loss of cultural values embedded in indigenous languages (Odejobi et al., 2015; Aládé et al., 2015; Ajagbe, 2024).

In recent years, digital technologies have opened new frontiers for language learning and revitalization. Animation offers an engaging and visually stimulating means of instruction, especially for children and young learners (Bowo and Lubis, 2022; Fatmawati, 2024; Silaban et al., 2023; Reza, 2024). By combining visual storytelling, culturally relevant contexts, and auditory cues, animated learning systems can enhance comprehension, retention, and learner motivation (Mulyani et al., 2024; Nayan, 2024; Mu and He, 2024).

The present methods of teaching and learning *Yorùbá* are essentially conventional, using textbooks, lectures, and rote memorization. A lack of digital resources and tools makes it difficult for students to practice and enhance

their language abilities outside of class. Furthermore, the *Yorùbá* language is losing popularity and proficiency as English and other global languages gain traction (Aládé et al., 2015; Eludiora and Akinbande, 2019; Sadiku, et al., 2015 (a); Sadiku, et al., 2015 (b)). This decrease is particularly worrying because *Yorùbá* is a rich and complex language with a distinct cultural legacy that should be maintained and promoted (Odejobi et al., 2015; Ninan et al., 2020).

To address these issues, *Yorùbá* language teaching requires a more imaginative and interesting method. This paper presents the development of an animated *Yorùbá* language learning system aimed at promoting language acquisition through an immersive, interactive, and culturally grounded approach. The system integrates 3D animated characters and environments, recorded Yorùbá audio content, and multimedia learning tools to create an engaging platform for learners. The domain for the Yoruba language learning system includes *Yorùbá* alphabet and numbering system.
The specific objectives are to:

1) Design culturally appropriate *Yorùbá* language learning content and develop a comprehensive storyboard that guides the instructional animation flow.
2) Create 3D models of characters and environments that reflect real-life *Yorùbá* cultural settings for use in the animated learning scenes.
3) Implement the designed 3D animations and integrate them with recorded *Yorùbá* language audio, interactive multimedia elements, and narration.
4) Evaluate the performance of the developed animated *Yorùbá* language learning system using mean opinion score (MOS).

Over the years, significant research has been dedicated to leveraging digital tools—ranging from multimedia platforms to animated videos and intelligent systems—for enhancing language learning, especially in the context of low-resource and indigenous languages. These studies have explored diverse approaches, learner demographics, linguistic targets, and technological innovations, each contributing unique insights that inform the development of this animated *Yorùbá* language learning system.

One of the earliest examples is the work of Katushemererwe and Nerbonne (2015), who developed an e-learning platform to aid the relearning of *Runyakitara*. Their system, though primarily text-based, laid a foundational model for indigenous language revitalization through interactive vocabulary and grammar exercises. Ninan et al. (2019) tackled a fundamental orthographic challenge in *Yorùbá* —tone marks and diacritics—by gamifying diacritic insertion.

Several studies have explored the use of animation for teaching science and language concepts. For instance, Mujahidah (2022) created an animated video to teach blood composition and functions, while Wardana and Adlini (2022) animated the respiratory system to support science education. Similarly, Reza (2024) used the Animaker tool to animate the human digestive system.

In the realm of vocabulary learning, Bowo and Lubis (2022) and Amaliah et al. (2023) designed English vocabulary learning videos, embedding real-life scenarios and interactive visuals. Efforts in teaching Arabic, such as those by Ni'mah et al. (2024) and Mubarak and Utomo (2024), used animated content to improve listening and speaking proficiency. These projects inform our system's integration of voiceovers and culturally relevant dialogue for listening comprehension in Yorùbá.

Significant strides have also been made in *Yorùbá* -specific technologies. Eludiora and Akinbande developed a multimedia learning system incorporating text, audio, and visuals for teaching *Yorùbá*, though it lacked animation. Aládé et al. (2015) and Ninan et al. (2022) advanced cultural preservation through animated folktales. The web-based system developed by Odejobi et al. (2015) supported learning in *Yorùbá*, Igbo, and Hausa, offering syllable drills and grammar modules. While robust, its interface was predominantly text-driven.

Beyond African contexts, animated learning tools have flourished globally. Ventivani et al. (2021) addressed Mandarin learners' struggles with grammar through animated directional complements. Likewise, Fatmawati et al. (2024) and Septiani et al. (2024) developed Mandarin and English videos to support beginner vocabulary acquisition. Pujiani and Almustaflikhah (2022) and Mulyani et al. (2024) designed comprehensive animation-based materials for English skill acquisition among young learners.

Technologically advanced systems like that of Mu and He (2024) integrated voice-operated character animation and speech recognition. Similarly, Bragg et al. (2018) and Nayan et al. (2024**)** emphasized accessibility by developing animated American sign language (ASL) and Indian sign language (ISL) applications for persons with hearing and speech impairments, reinforcing the potential of inclusive animated platforms.

Innovative formats such as e-comics and Podtoon have also been explored. Sukma and Setyasto (2024) merged comic storytelling with video to teach blood circulation, while Silaban et al. (2023) used Podtoon animation to simplify macroeconomic theories. Novianti et al. (2023) applied 2D animation to the TAPPS model in mathematics to reduce phobia—a technique we find valuable in reducing language anxiety among first-time learners. Furthermore, the works of Perez et al. (2021) and Sirait et al. (2023) highlight the role of animated educational content in embedding cultural values and improving numeracy respectively.

Together, these studies demonstrate the efficacy of animated learning tools across languages and disciplines. Yet, a notable gap remains in child-oriented, culturally rich, and linguistically accurate animated platforms for *Yorùbá*. This paper addresses this by integrating 2D animation, native voiceovers, vocabulary drills, tonal practice, and interactive dialogue—all grounded in *Yorùbá* cultural context and tailored for foundational learners.

The rest of this paper was organized as follows: Section 2 details the methodology for this study. In Section 3, the results and discussion are presented. Section 4 entails the conclusion and recommendations for future studies

2. Methodology

2.1 Curriculum and Content Design

The curriculum for the animated *Yorùbá* language learning system was developed specifically to focus on letters and numbers. The Nigerian *Yorùbá* alphabet consists of 25 letters, omitting the English letters C, Q, V, X, and Z, and including unique *Yorùbá* characters such as Ẹ, Ọ, Ṣ, and Gb. Each letter was presented with culturally relevant examples to aid understanding (e.g., A – *àjà*, B – *bàtà*, etc.).

The number lessons cover numerals from 1 to 1000 in *Yorùbá*. Proper pronunciation, tonal markings, and intonation patterns, which are essential features of the Yorùbá language, were carefully incorporated into the script. These were then synchronized with the animated characters and scenes to provide learners with an engaging and accurate visual-auditory learning experience.

2.2 Animation Development

The activities involved in the design of the *Yorùbá* language learning animation were:

a) Storyboards: The animation features three main characters: a teacher and two students, one boy and one girl as shown in Figure 1. The teacher serves as the central figure and narrator, guiding the lesson and introducing the *Yorùbá* alphabets and numerals. The students represent the learners and actively participate by listening and repeating after the teacher to reinforce the lessons.

The storyboard follows a linear, classroom-based sequence, where all teaching and interactions take place in a single setting. The teacher delivers the lessons while the students respond in unison. This format creates a structured and engaging learning environment that mimics a typical classroom session.



Figure 1 The storyboard for the animation

b) Environment Modelling: The environment for the project was modelled as a classroom setting, complete with a board, chairs, and tables. The entire animation maintained a single camera angle, positioned at the back of the classroom to capture the full scene, including all elements and lighting.

To create the classroom environment in blender, the first step was using the Shift + A button to add a mesh and insert the cube, which was resized to match the dimensions of a typical classroom. Using the modifier option the cube

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was given thickness and height. Loop cuts were added to the edges of the models which were then subdivided to create more geometry and sculpt finer details; rectangular mesh was tweaked and merged to the room wall to act as a window. The chair, table, bag, books and shelf were downloaded online and imported into the scene. The board in the classroom was created using a rectangular mesh and joined to the side of the classroom using Ctrl + J. The environment modelling is depicted in Figure 2.

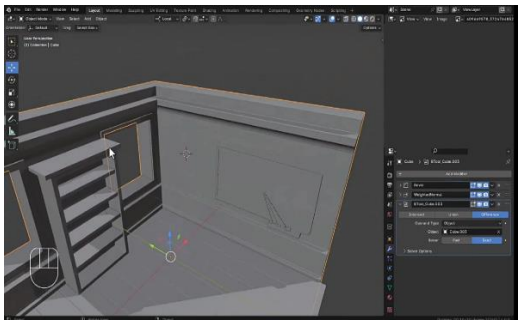


Figure 2: The classroom environment designed in blender software

c) Character Modelling: The design of the teacher's character began with modelling the head. A horizontal axis, vertical axis (UV) sphere was added using Shift + A, and after switching to Edit Mode, the G (grab), Z (constrain to Z-axis), and R (rotate) keys were used to shape the sphere into the desired head form. The Subdivision Surface Modifier was applied to smooth out the geometry.

Facial features such as the eyes, nose, and mouth were created separately as individual meshes and then joined to the head using Ctrl + J. Each component was textured and coloured appropriately to enhance realism. The body, arms, and legs were also created from basic mesh shapes and adjusted using similar transformation tools and modifiers to achieve the intended character design. This is shown in Figure 3.

Student characters were modelled using male and female sample assets sourced from Sketchfab in FBX format, with textures already included. These models were imported into Blender, where both the mesh and armature were adjusted. Vertex manipulation techniques were used to refine the body shapes and polygonal features (faces and contours) to better fit the animation style. Since the storyboard specifies non-action roles for the characters, the rigging was simplified and posed in a seated position.



Figure 3: The teacher character designed in blender software

d) Rigging and Animation: After completing the character design, the rigging process for the teacher character began by exporting the character mesh as an FBX file with embedded textures. This file was then uploaded to Mixamo, an online three-dimensional (3D) animation platform, where an appropriate rig was selected to match the animation requirements.

The rigging was configured to support upper-body movement—from the head to the waist—allowing the teacher character to turn toward the students and the board, as well as move the head and hands to simulate teaching gestures. To integrate the animation into Blender, the Mixamo add-on was installed, which enabled direct import of the rigged character and animations in FBX format. The rigging process is shown in Figure 4.



Figure 4: Rigging controls added to the character

e) Shading, Texturing, and Lightening: After completing the 3D modelling of the characters, the models were prepared for texturing by unwrapping their UVs using Blender's UV Editing tools. This process enabled two-dimensional (2D) texture images to be accurately mapped onto the 3D surfaces of the models.

A brown gradient texture was applied to simulate the skin tone of indigenous *Yorùbá* speakers. Hair and beards were textured using repeatable black patterns, with individual strands added to enhance realism. Clothing was textured with vibrant, colourful patterns representative of

traditional *Yorùbá* attire, giving the characters a culturally authentic appearance.

Using Blender, both exterior ambient and interior lighting were created to ensure that the scenes were well-illuminated and visually clear. By switching to Rendered Viewport Shading, various lighting elements were added and adjusted to enhance realism.

Area lights were used throughout the scene to provide soft, even illumination, making the classroom environment more convincing. A spotlight was specifically directed at the teacher character to draw attention and create emphasis. Additionally, shadow effects were added and carefully adjusted to increase the overall depth and realism of the scene. For each lighting configuration, render tests were conducted to evaluate the effect on individual frames and ensure consistency across the animation.

In the timeline panel on blender, using the graph editor, keyframe was added and animation of the modelling was done by keeping the transform and inserted a rotation and location keyframe using I and G to tilt our character to the intended movement. The animation was set at 24 frames per second and changes required in the timing of the animation were affected before the rendering. Figure 5 depicts an overview of the animation process in blender.

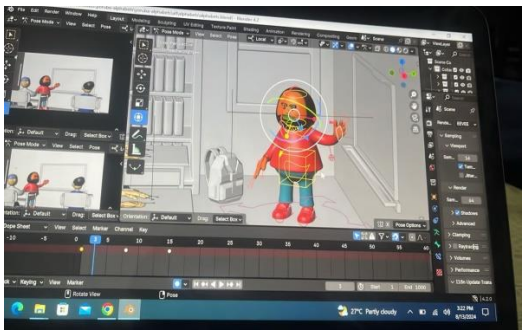


Figure 5: Overview of the animation process in blender

f) Audio Synchronization and Content Display: The audio content for the animation was voice-recorded by native *Yorùbá* speakers to ensure accurate pronunciation and intonation, resulting in high-quality and clear narration. Sound effects, such as lullaby tunes, were added to enhance the auditory experience and add emotional depth to the animation. The WAV audio format was used for its high fidelity and compatibility with the animation system.

The *Yorùbá* learning content was displayed on the classroom board as the lesson progressed, creating the illusion that both the teacher and student characters were actively engaging with the material. This was achieved by using the 'Add' button in the Timeline panel, selecting the 'Text' option, and inputting the relevant content gathered from the lesson materials. Further formatting was applied to the text, including adjusting its appearance and synchronizing the text transitions with the corresponding audio. This ensured that the visual display of the lesson matched the spoken content in real time.

g) Rendering and Compositing: To render the animation, the first step was enabling 'View' options in the Render section of Blender, which allowed for ambient lighting inclusion and visibility adjustments. Basic scene renders were previewed using the F12 key.

The cycles render engine was used for final output due to its ability to produce high-quality results with realistic lighting and materials. The resolution was set to Full HD (1920×1080), and Denoising was activated to reduce noise in the final frames. The animation was rendered in AVI format, and the final video had a total duration of 6 minutes and 21 seconds. The post-production phase of the animation involved fine-tuning the scenes and applying special effects to enhance the visual quality. The process began in Blender's Compositor workspace, where nodes were added using Shift + A.

Colour correction and lighting adjustments were made by connecting nodes such as Colour Balance, Hue/Saturation, and Glare to the Render Layers and Composite Output. These enhancements allowed for better visual contrast, mood, and clarity across the animation sequence. Figure 6 shows a snapshot view of the final state of the animation after full integration



Figure 6: A snapshot view of the final state of the animation after full integration

3. Evaluation

Evaluation was carried out to assess the usability of the animated *Yorùbá* language learning system. To conduct this evaluation a questionnaire was created to garner responses from test users. The questionnaire contained 25

questions, divided into 5 categories - Usability, Accuracy, User-friendliness, Timeliness and responsiveness – with five questions under each category. Responses were rated on a 5-point Likert scale: 5 – Excellent, 4 – Good, 3 – Neutral, 2 – Fair, 1 – Poor.

3.1 Mean Opinion Score (MOS)

The Mean Opinion Score (MOS) technique was used to analyze the responses. Each participant's selection was converted into its corresponding numerical value. For each question, the sum of all 15 participant scores was computed and divided by 15 to obtain the average score per question. Subsequently, the average score for each parameter was calculated as the mean of the five associated questions as shown in Equation 1.

$$Q_1 Mean = \frac{Sum\ of\ values\ from\ Q_1}{15} \qquad (1)$$

$$Average\ usability = \frac{Q_1Mean + Q_2Mean + Q_3Mean + Q_4Mean + Q_5Mean}{15}$$

This process was repeated for all five parameters Q_1as with the result in Table 1.

Table 1. User Evaluation Scores by Parameters

Parameters	Mean Score	Percentage %)
Usability	4.81	96.20
Accuracy	4.93	98.60
Timeliness	4.87	97.40
User-friendliness	4.75	95.00
Responsiveness	4.76	95.20

These values were calculated using the formula shown in Equation 2.

$$MOS(\% = \frac{Mean\ score}{5}\ x\ 100\% \qquad (2)$$

3.2 Discussion of results

1. Usability (96.20%): Users found the system generally easy to use and intuitive. Most participants reported smooth navigation through lessons and activities.
2. Accuracy (98.60%): The system performed exceptionally well in delivering accurate content, translations, and culturally relevant examples. Nearly all users agreed that the instructional materials aligned well with the intended learning outcomes.
3. Timeliness (97.40%): Users appreciated the speed and smoothness of transitions between lessons and activities. The system loaded quickly, and users reported minimal waiting times.
4. User-friendliness (95.00%): The interface was well-received in terms of accessibility and ease of interaction. Controls such as playback speed, volume, and animation responsiveness were praised.
5. Responsiveness (95.20%): Users experienced fast and reliable system feedback when interacting with features such as audio, video, and screen resizing. There were no significant lags or delays.
6. Animated characters, audio-visual narration, and structured lesson modules are all incorporated into the system in order to teach *Yorùbá* pronunciation, as well as fundamental vocabulary, sentence form, and cultural themes. When users were evaluated using the Mean Opinion Score (MOS) method, the results showed that they provided overwhelmingly positive comments about key usability factors. These parameters included correctness, timeliness, user-friendliness, responsiveness, and overall usability. The system indicates a strong potential as an effective instructional tool, particularly for youngsters and beginners who are interested in learning the *Yorùbá* language. It has mean scores that are higher than 4.0 out of 5.0 across all parameters, and it has an accuracy score of 98.6%.

4.0 Conclusion and Future Work

This study presented the design, development, and evaluation of an animated *Yorùbá* language learning system aimed at promoting indigenous language acquisition through interactive and engaging multimedia tools. The system integrates animated characters, audio-visual narration, and structured lesson modules to teach basic vocabulary, sentence construction, cultural elements, and pronunciation in *Yorùbá*. User evaluation through Mean Opinion Score (MOS) analysis revealed strong positive feedback across key usability parameters—namely accuracy, timeliness, user-friendliness, responsiveness, and overall usability. With mean scores above 4.0 out of 5.0 in all metrics and an accuracy score of 98.6%, the system demonstrates high potential as an effective educational tool, especially for children and beginners interested in learning the *Yorùbá* language. The results underscore the importance of combining culturally relevant content with user-cantered interface design to foster better engagement and learning outcomes in indigenous language education. While the animated *Yorùbá* learning system demonstrates great promise, several avenues exist for future improvement and expansion:

1. Content Expansion: Conversation modules and context-specific lessons (e.g., greetings, storytelling, and proverbs) can be

incorporated to enrich the learning experience.
2. Gamification: Incorporating interactive games, quizzes, and reward systems could increase learner motivation and retention.
3. Mobile App Development: Porting the system to Android and iOS platforms would significantly enhance accessibility and usability on mobile devices.
4. Multilingual Support: Providing explanations and translations in multiple major languages (e.g. Hausa, Igbo) could increase inclusivity and cross-cultural learning.
5. Scalability and Cloud Deployment: Hosting the system on a cloud platform would enable broader access, real-time updates, and the possibility of integrating user analytics for ongoing improvement.
6. Formal Curriculum Alignment: Aligning the system with school syllabi and collaborating with educational stakeholders could facilitate its adoption in formal education settings.

In conclusion, this work contributes to the growing field of educational technology for indigenous languages and sets a foundation for future enhancements that can transform the way *Yorùbá́* and other local languages are taught and preserved in the digital age.

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