Assessment of Users Perception of a English to Yoruba Computer Aided Translation Teaching System (CATTS) for Climate Change Literacy

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ABSTRACT
Increasing environmental awareness and education on climate change has been identified as potential tools to combat climate change crisis. According to the United Nations Framework Convention on Climate Change (UNFCCC), all parties to the convention are responsible for launching educational and public awareness initiatives on climate change, as well as making sure that the general public accesses programs and information on the subject.

Education, particularly digital education has been identified as a potential tool to combat climate change. However, a very huge percentage of instructional materials and digital contents on the internet on climate change are in English language which is not the native language understood by the majority of the population of Africans. Translation and interpretation are the bridges that make cross-cultural and cross-linguistic communication possible.

In this paper an assessment of user's perception of a English to Yoruba Computer Aided Translation Teaching System (CATTS) for Climate Change Literacy was carried out. A questionnaire was developed and administered to different categories of respondents who understand both English language and Yoruba language with or without prior knowledge of climate change literacy and green innovation entrepreneurship. After interacting with the developed Computer Aided Translation Teaching System (CATTS) for Climate Change Literacy (CCL) in Yoruba language, the uses were evaluated on the level of translation accuracy of the system on CCL concepts, the system's reliability, user friendliness, users understandability of CCL and the need to mitigate the activities that contributes to climate change. The system had an overall 91.3% translation accuracy and 87.0% translation error. Statistical analysis of respondent feedback from the survey conducted revealed that users were satisfied with the developed system with a significant majority, 89.0% agreeing that employing the Computer Aided Translation System for translation could enhance the teaching and understanding of Climate Change in Yoruba language, the translation efficiency, usability and reliability of the system were highly rated.

Key words: Users Perception, English to Yoruba Translation, Computer Aided Translation Teaching System, Climate Change Literacy

1. INTRODUCTION
Climate Change (CC) is one of the most devastating crises of the 21st century, causing devastating havoc across the globe. Floods, wildfires, droughts, heatwaves, extreme weather and tropical storms are just a few examples of the CC evidence that are becoming more erratic, extreme, and frequent. Unless all nations unilaterally take proactive measures, CC will become a major threat to food and water security, and its impacts can exacerbate global economic

inequality and international peace as competition for resources such as land, food, and water, fuels socio-economic tensions (IPCC, 2016; Diffenbaugh & Burke, 2019).
The climate change crisis is a realty threatening the existence of the entire ecosystems of the earth and its effects is already being felt and the Intergovernmental Panel on Climate Change (IPCC) has continued to raise alarm on the rise in global temperature of the earth leading to global warming and the long term effect of change in earth Climate which is now having significant impact on the planet with attendant manifestations in Rising temperatures, droughts and desertification, heavy precipitation, flooding and rising sea levels, extreme weather events such as cyclones, floods and droughts (Julia et al 2023, Department of Agriculture, Water and the Environment. (2021)). There is therefore urgent need to mitigate activities and actions that contribute to global carbon emission and greenhouse gas (GHG) effects. The problem is global and hence requires global effort of everyone to attain to the global net zero carbon and global temperature limit of 1.5^{o}C goal of the United Nations (UN) Climate Change Conference (COP26) conference on climate change held in 2021.

Africa is the world's hottest and second largest continent on Earth with 54 countries, however, according to (Lee, Markowitz and Howe, 2015), Africa has the lowest level or percentage of climate change awareness. Most people in Africa are not aware of environmental issues, Therefore, if a person can't speak a certain language or isn't aware of environmental issues, how could they understand the meaning of global warming or do anything against climate change? One of the best ways to help people in Africa address climate change is through education and access to information, through language translation and interpretation technologies and systems. Translation and interpreting are the bridges that make cross-cultural and cross-linguistic communication possible.
Approximately 1,000-2,000 different languages is spoken across the continent of Africa, Not everyone can understand scientific or specialized words such as global warming, if explanations about environmental issues, their effects and their causes are available in their native languages, this might help people in Africa to be better-equipped to face and address climate challenges.

Translation is more than converting or conveying text or words, it is about capturing the heart of a person who is either listening or learning. Research has further shown the positive impact of Mother Tongue-Based Multilingual Education (MTB MLE) in ensuring learners from non-dominant language groups acquire strong foundational skills in literacy and numeracy, as much as 40% of the global population does not have access to an education in a language they speak or understand. Education and learning becomes difficult and frustrating for those in that category.
In this work an assessment of a developed ethno-linguistic computer aided translation system for the Yoruba speaking populace of Nigeria was carried out. Yoruba is a member of the Volta-Niger branch of the Niger-Congo family of languages. It is spoken by about 43 million people, mainly in southwestern Nigeria (National Population Census, 2006), and also in Ghana, Benin, Togo, Côte d'Ivoire and Niger. Yoruba is spoken by about 42 million people in Nigeria, Yoruba is one of the four official languages of Nigeria, along with English, Hausa and Igbo, and the de facto provincial language in the southwestern region It is taught in schools, and used in newspapers, television, radio and literature. In Benin republic Yoruba is spoken by about 209,000 people, especially in Porto-Novo city in the southwest. Yoruba is taught in some primary schools in Benin. Other countries with significant numbers of Yoruba speakers include Ghana (460,000), Togo (117,000), Côte d'Ivoire (115,000) and Niger (74,800).
Yorùbá is a tonal language with three phonological contrastive tones: High (H), Mid (M) and Low (L). Phonetically, however, there are two additional allotones or tone variances namely, rising (R) and falling (F), Bamgbose A. (1966) and Cornell and Ladd, (1990). Yoruba is also known as Yariba, Yooba or Yorùbá. There are five groups of Yoruba dialects: Northwest,

Northeast, Central, Southwest and Southeast. The Northwest dialects of Ọyọ and Ibadan are the basis for Literary Yoruba or Standard Yoruba (SY) (Adewole, 1988), the formal written version of Yoruba.

2. REVIEW OF LITERATURE

Education is a fundamental tool for advancing action on climate change, yet it has not been adequately tapped for its potential. Better climate education, according to the Global Commission on the Economy and Climate, may lead to at least $26 trillion in net global economic gains and over 65 million new low-carbon employments. Education is crucial for creating the workforce that will be needed to realize these benefits (Julia et al 2023). Some of the additional advantages that education on CC may bring include the furthering of investments at the nexus of sustainability and digitalization, improving inter-disciplinary climate research, and developing policies for education and climate change that reinforce each other.

Translation is necessary for the spreading of new information, knowledge, and ideas across the world. In the past, language translation has played vital role in information/knowledge dissemination and awareness campaign of global pandemics and other global life-threatening disasters (World Economic Forum 2022). It is in line with this that the UNFCCC and UNESCO is calling for global Climate Change awareness through education and consequently educational translation teaching systems (UNESCO and UNFCCC, 2016). In combating climate change challenge in Africa through education and public awareness, it is necessary to achieve effective communication in different cultures and languages (Tunde et al 2022). This can best be achieved using contextualized translation teaching systems.

The UNFCCC prioritized 6 key areas of activity to achieve action on climate change through learning and they are: education, training, public awareness, public access to information, public participation, and international cooperation see Table 1

Table 1: The 6 key areas of action prioritized by United Nations Framework Convention on Climate Change (UNFCCC)

Scope	**Objectives**	
Education	Change Habit in the Long Term	Foster a better understanding of, and ability to address Climate Change and its effects
Training	Develop Practical Skill	
Public Awareness	Reach People of all age and walks of life	Promote Community engagement, creativity and

Public Access to Information	Make information freely available	knowledge in finding climate change solution
Public Participation	Involve all stakeholders in decision making and implementation	Engage all stake holders in debate and partnership to respond collectively to climate change
International Cooperation	Strengthen cooperation, joint efforts and knowledge exchange	

Source: (UNESCO and UNFCCC, 2016, p. 3, based on UNFCCC, 2005, Article 6)

Zhiqiang, Juning and Weixuan (2022) presented a research work, "Design of Computer-Aided Translation System Based on Naïve Bayesian Algorithm", the work theoretically analysed some key technologies in computer-aided translation and implemented a computer-aided translation systems based on the fusion of naive Bayesian algorithms for Chines to English language translation.
In Yang (2022) an RNN based Neural Network Model for Chinese-Korean Translation Learning was developed. The translation model in the study an improved RNN model is designed the model introduces a new encoder and upgraded the RNN neural network with a decoder matching mode, allowing it to learn both alignment and transformation at the same time. for quicker neural network training, resulting in increased translation, speed and efficiency. **Wei and** Bei (2022) introduced the CorpTrans system, which analyzes the practical effect of computer-aided translation system applied in the course teaching, verifies the role of the system in computer-aided translation course teaching, and plays an important role in improving students' translation ability.
Akinwale, Adetunmbi Obe., Adesuyi (2015) Presented a Web-Based English to Yoruba Machine Translation which deals with the translation of English text to Yoruba text using rule-based method. A bilingual dictionary dataset containing English words and the corresponding translation in Yoruba language was used. The translator was evaluated to have accuracy of 90.5%.
Eludiora and Odejobi (2016) The study formulated a computational model for English to Yorùbá text translation System, Digital resources in English and its equivalence in Yorùbá were collected using the home domain terminologies and lexical corpus construction techniques. It was designed and tested using Natural Language Tool Kits (NLTKs).

Onyenwe, Onyedinma, Aniegwu and Ezeani (2019) Worked on Bootstrapping Method For Developing Part-Of-Speech Tagged Corpus In Low Resource Languages Tagset- A Focus On An African Igbo, the work established that POS tagged corpus is essential for natural Lan They presented the cross-lingual and monolingual POS tags projection and used cross-lingual to automatically create an initial 'errorful' tagged corpus for a target language via word-alignment.

Tunde et al (2022) evaluated the awareness, Knowledge level and perception of climate change impacts and adaptation measures by rural people in southwestern Nigeria.

3. MATERIAL AND METHOD

The dataset used for this research was extracted from the instructional design learning material developed in this work for carbon literacy and green innovation entrepreneur. The dataset consists of 200 keywords of carbon literacy and GIE and 289 (sentences, phrases and definitions) of

key concepts in carbon literacy and GIE. For each of the extracted 200 keywords, the Yoruba translation was given by the researcher. Table 2 shows the Data Set of Keywords/Terms Extracted from Instructional Learning Material of CL&GIE which formed part of the pre-processed data presented to the LSTM model for training and subsequently the translation system developed.

The 289 sentences and definitions of key concepts of carbon literacy and GIE were categorized and appropriately labelled to fall into various categories such as basic science of climate change, carbon footprint, literacy, Green Innovation, Global warming potential, Roles of Stakeholders, Urgency of Taking Actions etc. for the 289 sentences and definitions of key concepts of carbon literacy and GIE, Yoruba translation for the equivalent of the 289 sentences and definitions were given by human translator (the researcher). Table 3 shows the Dataset of Sentences and definitions of key concepts of CL and GIE in English language and the Yoruba Translation. The 289 sentences and definitions consist of 7,470 English words, the label categorization consist of 525 English label words while the Yoruba Translation equivalent of the 289 sentences and definitions is 8,959 words.

In order to provide complete grammar and sentence structure for all the parts of sentence (POS) in English language which will form the basis for constructing correct English language sentences and subsequently the Yoruba translation equivalent for this research, another dataset of English to Yoruba translation containing 122,422 words was acquired online and integrated into the carbon literacy and GIE dataset, making the total dataset for this research work 139,051 text data, however, for the purpose of implementation of the LSTM based neural CAT system developed in this research, only 5000 total pairs of the dataset was used, for ease of implementation on the available computer resources (processor and memory) out of the 5000 total pair, 3500 was training pairs, 750 validation pairs and 750 testing pairs.

Table 2 the Data Set of Keywords/Terms Extracted from Instructional Learning Material of CL&GIE

Data Set of Keywords/Terms Extracted from Instructional Learning Material of CL&GIE					
SN	Carbon Literacy Key word/Term (English)	Translation in Yoruba	SN	GIE Key word/Term (English)	Translation in Yoruba
1	Weather	Oju Ojo	27	Green Innovation	Ilána• tuntun alawo• ewe
2	Atmosphere	Afefe	28	Recycling	Atunlo
3	Minute	Iseju	29	Bottles	Awon Ego
4	Hour	Wakati	30	Glass	Gilasi
5	Day	Ojo	31	metal scraps	Awon ajaku irin
6	Sun	Oorun	32	Technology	Imo ero
7	Sunny	Orun mu	33	Entrepreneur	Onisowo
8	Rain	Ojo	34	Green Economy	Aje alawọ-ewe
9	Climate	Oju Ojo	35	Green	Isowo Alwo-

				entrepreneurship	ewe
10	Years	Odun	36	sustainable development	Idagbasoke to duro-sinsin
11	Global warming	Imorusi agbaye	37	Environmental sustainability	agbeero ayika
11	Climate change	Iyipada Oju Ojo	38	Waste Management	Isakoso egbin
12	Sea	Okun	39	Green Activities	Akitiyan Alawo-ewe
13	Earth	Ayie	40	Clean Energy	Agbara mimọ
14	Greenhouse Effect	Ipa eefin gaasi	41	Renewable Energy	Agbara iso dotun
15	Mountains	Awon Oke nla	42	sustainable land use	Agbeero Ile lilo
16	Galciers	Awon yinyin	43	Sustainable manufacturing	Agbeero Iseda

Table 3 Dataset of Sentences and definitions of key concepts of CL and GIE in English language and Yoruba Translation

S/N	Source Text/Sentence (English) Climate Change Literacy	Category/Label	Target Translation (Yoruba)
1	Climate change is primarily caused by the increase in greenhouse gas emissions.	Basic Science	Ni Pataki, itujade gaasi efin lo ma n fa iyipada oju-ojo
2	The carbon footprint of a product measures the amount of greenhouse gases emitted during its production, use, and disposal.	Carbon emission footprint	Onte kaboni ohunkan n won iye awon gaasi eefin to tu jade nigba ti a n daa, lo ati daanu.
3	Urgent action is needed to mitigate the impacts of climate change and prevent irreversible damage to the planet.	Urgency of Taking Actions	Anilo igbese Kankan lati dinku ipa iyipada oju-ojo ati didana ofo tikolaaro
4	Governments play a crucial role in implementing policies and regulations to reduce carbon emissions and combat climate change	Roles of Stakeholders	Awon ijoba n sa ipa Pataki lati se agbekale ilana ati awon ofin lati dinku itujade kaboni ati didoju ija ko iyipada oju ojo
5	Rising global temperatures result in melting glaciers, rising sea levels, and more frequent extreme weather	Basic Science	Piposi iwon otutu agbaye lo ma n fa yiyo awon yinyin, lilo soke ipele okun, ati awon isele

	events.		lore kore to tayo ala
6	Transportation is a significant contributor to carbon emissions, and promoting electric vehicles can help reduce pollution and combat climate change.	Carbon Emissions Footprints	Lilo ati bibo oko lo n dakun itujade kaboni, atipe gigbe laruge awon oko eleletiriki ma mu adin kun ba biba oju-ojo je ati kikoju ija si iyipada oju-ojo
7	Literacy refers to the ability to read and write. Carbon literacy specifically pertains to knowledge and understanding of carbon-related concepts, including climate change, carbon footprints, and mitigation strategies.	Literacy	Imo iwe, tumo si agbara lati ko ati ka. Imo nipa kaboni je nini oye paato nipa imo ati oye awon ohun to sopo mo kaboni ninu eyiti iyipada ojuojo, ohunte kaboni ati awon liana idena wa.
8	Global warming potential (GWP) is a measure of how much a given greenhouse gas contributes to global warming over a specific time period, compared to carbon dioxide.	Global warming potential	Agbara imorusi agbaye (GWP) je iwon ti iye eefin gaasi da si mimoru agbaye fun akoko kan pato ni sise afiwe pelu gaasi kaboni.

Figures 1 and 2 shows the production rules and the state diagram for the Yoruba production rule used for the translation .

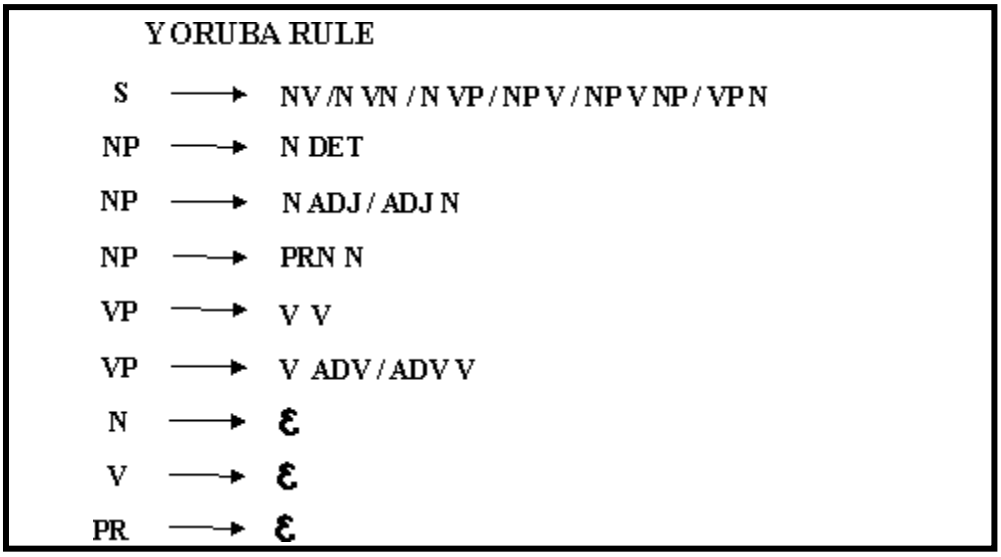


Figure 1. The production rule for the Yoruba language sentences

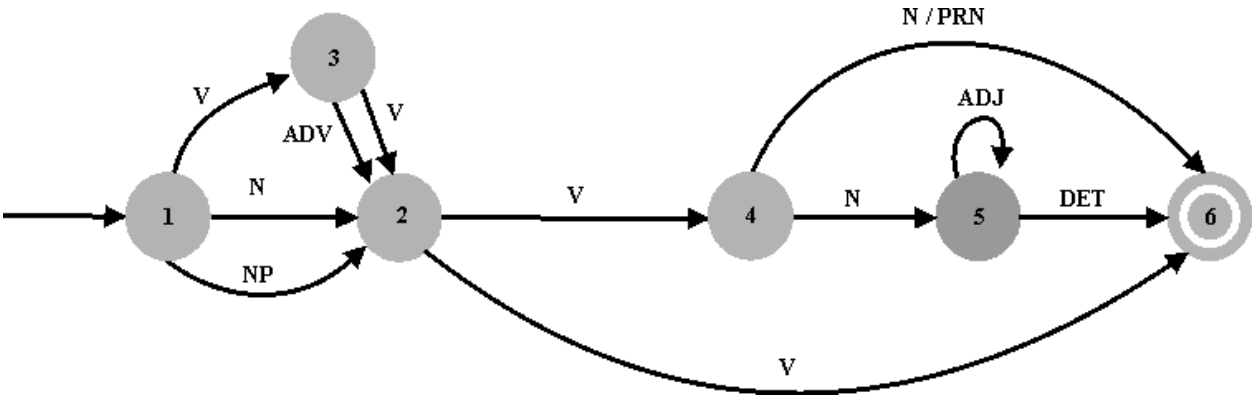


Figure 2. The State diagram of the Yoruba language Production Rule

4. RESULT

The interfaces of both the English and Yoruba versions of the CATTS are presented in the following section. However, emphasis is laid more on the Yoruba screenshots. Figure 3b is the Yoruba version of the home page or welcome page of instructional design learning material, It presents to the user a user-friendly, easy to navigate web page that introduces Carbon Literacy and Green Innovation Entrepreneur in Yoruba language ("Nini oye kaboni ati ilana titun fun idokowo alawo awe"). It also displays the home button, CL material button and GIE material button, the two modules and their expected contents all in Yoruba language. Figure 3d is the web page interface that presents learning objectives ("Awon Afojusun Eko") of the modules of the learning material; it also presents the overview of basic definitions of concepts in CL and GIE. Figure 4b presents the course content of module 1 of Carbon Literacy which involves the basic science of climate change where major climate change concepts such as "global warming", "climate Change", "Greenhouse Effect", "Carbon Footprint" all in Yoruba language.

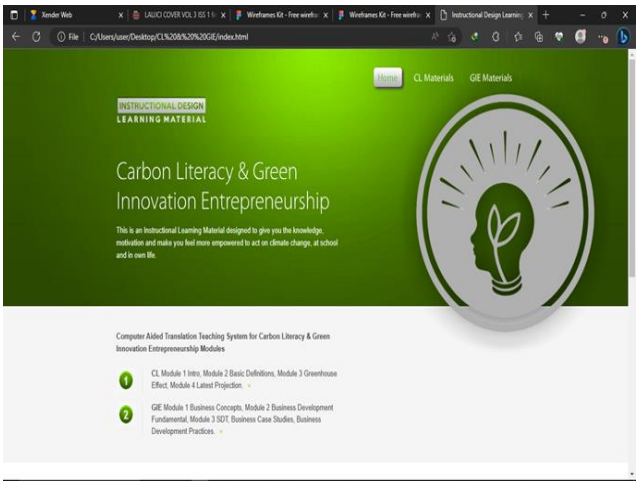


Figure 3a English language instructional design

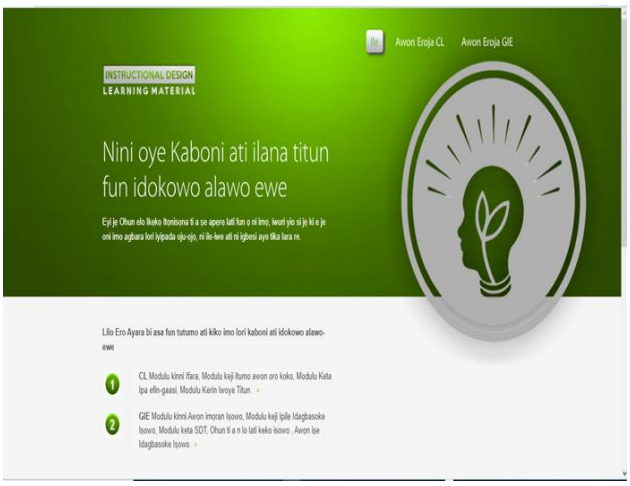


Figure 3b Yoruba language instructional design learning material home page

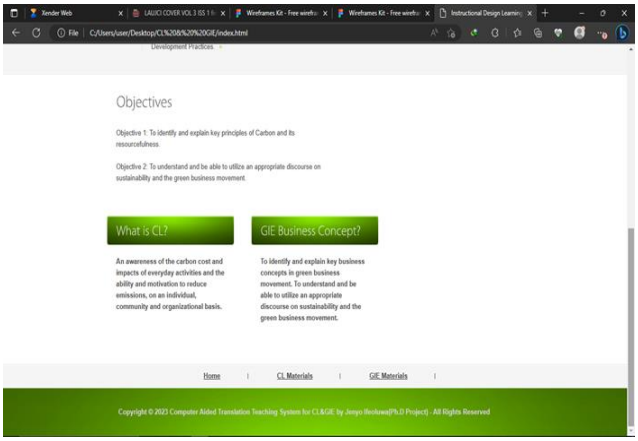
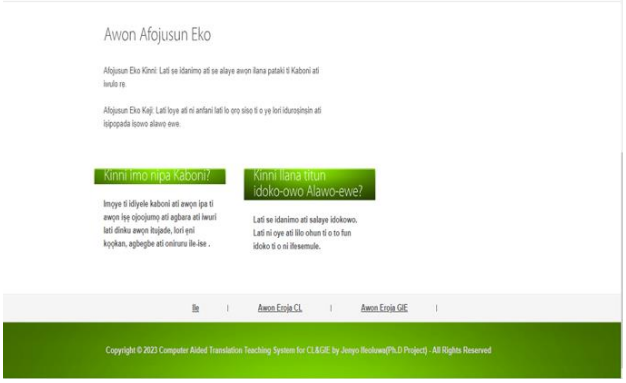
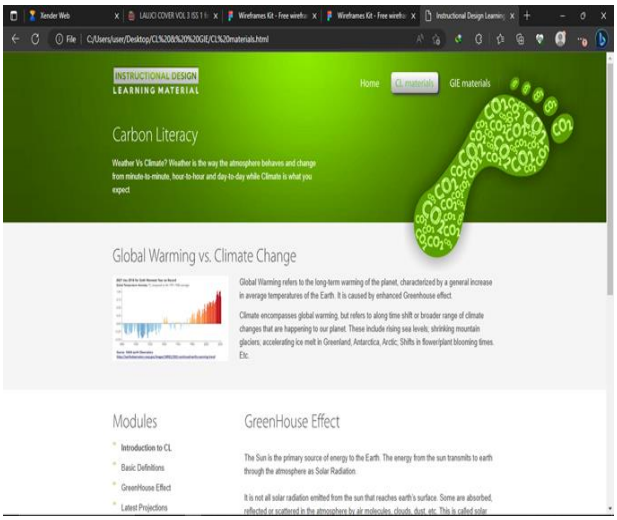
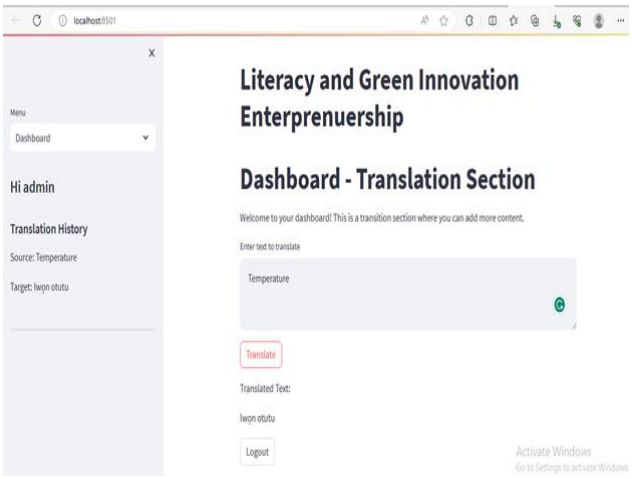


Figure 3d Web page interface showing the learning objectives in Yoruba language.





e 1 of Figure 4b Web interface showing course content of module 1 of Carbon Literacy in Yoruba



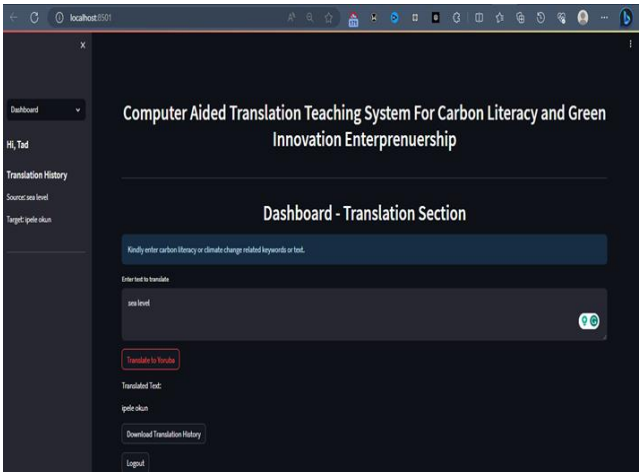
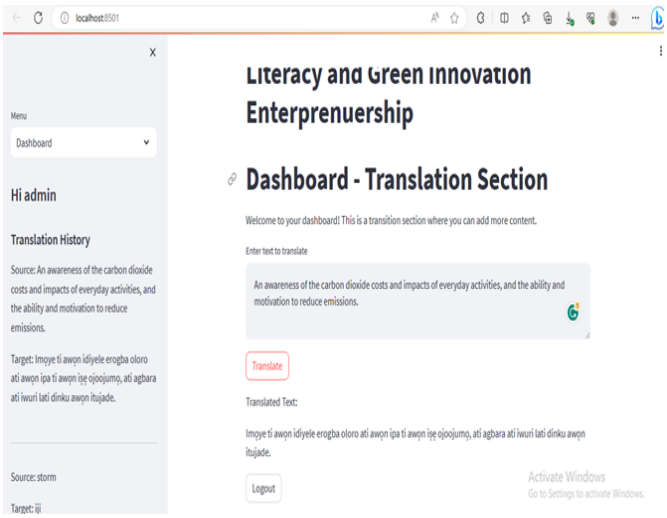


Figure 4c Dashboard of Translation Section of single CL Keyword Translation **Figure 4d of keywords in climate change.**



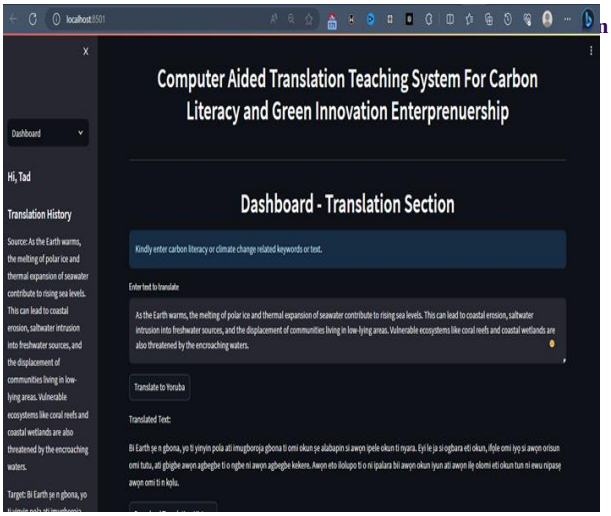
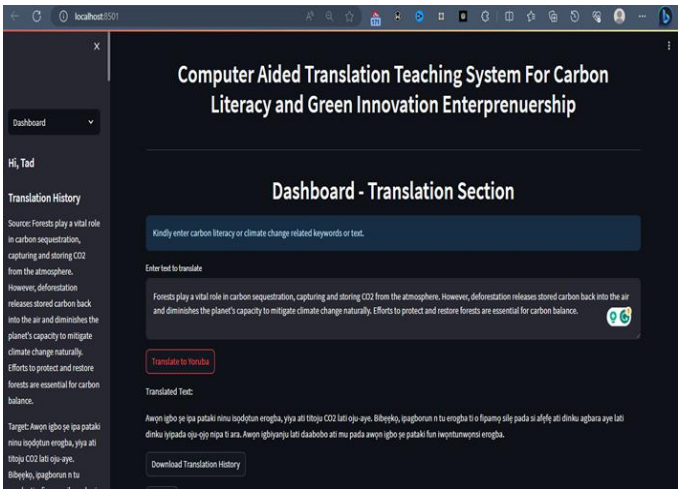


Figure 5b Translation of longer and more complex CL and GIE sentences.



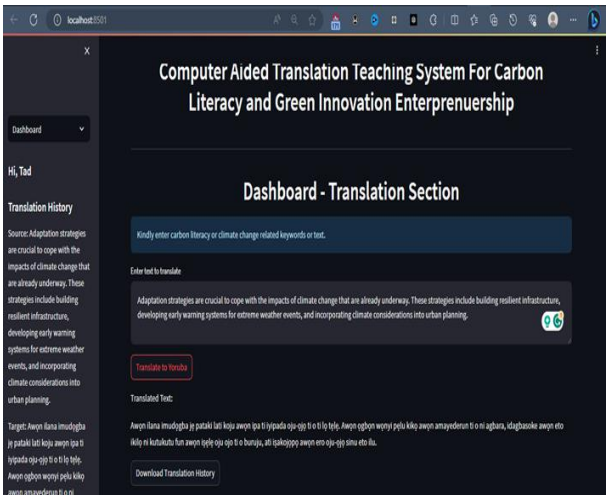


Figure 5c Translation of longer and more complex CL and GIE sentences **Figure 5d Translation of longer and more complex CL and GIE sentences**

Figure 4c is an interface of the CATTS showing the Dashboard of Translation Section, the dashboard consists of a prompt asking the user to enter a word, phrase or sentence to be translated. In this case the user entered a single CL keyword "Temperature" which upon clicking on the translate button, the system translated as "Iwon Otutu" as displayed in the lower part of the dashboard. The dashboard also shows the translation history, a section of the system that stores all translated source (English) text and translated target (Yoruba) text. figure 4d the CL English keyword entered was "Sea Level" and this was translated by the system as "Ipele Okun" as can be seen in Figure 4d.

In other to further test the translation efficiency of the developed CL4GIE Computer Aided Translation Teaching System (CATTS), CL and GIE phrases and long sentences were entered into the translation dashboard for translation. Figures 5a, 5b and 5c are examples of such. In Figure 5a the user entered the sentence "An awareness of the carbon dioxide cost and impacts of everyday activities and the ability and the motivation to reduce emissions" and this was translated by the system as "Imoye ti awon idiyele erogba oloro ati awon ipa ti awon ise ojojumo, ati agbara ati iwuri lati dinku awon ibujade". The source (English) text and the target translated (Yoruba) text is appended to the translation history section in Figure 5a.

A longer and more complex sentence was entered into the translation dashboard as shown in Figure 5b, the user entered the sentence "climate change refers to the long-term alteration of Earth's average weather patterns, including temperature, precipitation, and wind patterns. It is primarily driven by the increased concentration of greenhouse gas in the atmosphere, such as carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (NO_2). Human activities such as burning Fossil fuel, deforestation, and industrial processes, have significantly contributed to the rise in these gases, leading to enhanced greenhouse effect and subsequently global warming" and this was translated by the system as "Iyipada oju-ojo n tokasi iyipada igba pipe ti awon ilanaoju-ojoapapo ti Earth, pelu iwon otutu, ojoriro, ati liana awon afefe. O ti wan i akoko nipase ifokansi ti o positi awan gaasi eefin ninu afefe, gegebi erogba oloro (CO_2) , Methane (CH_4), ati nitrous oxide (N_2O). Awon ise eniyan, gegebi awon epo fosali sisun, ipagborun, ati awon liana ile-ise ti se alabapin ni Pataki si igbega ninu awon gaasi wonyi, ti o yori si ipa eefin imudara ati imorusi agbaye ti o tele".

4.1 PERFORMANCE EVALUATION

The performance of Computer Aided Translation Teaching System (CATTS) developed was evaluated to ascertain its translation efficiency. The translated output of the CATTS was compared with the exact translation of same CL and GIE words/sentences of a human experts and checked for "Any language mix-up?", "Any un-translated word?", "Any Ambiguity or Any linguistic Issue identified?", and there after the Translation percentage (%) accuracy/Type of Match is determined as shown in Table 4.

As can be seen in the Table 4, for single CL and GIE keywords and short phrases, the translated output of developed system is 100% exact match compared with the human expert, no form of ambiguity, no any form of mix-up and no un-translated words. However, it was observed that as the sentences become longer and more complex, certain mix-up were noticed in the translated output of developed system, sub-segments of the translations are correct while some are not, this is attributed to literal translation, which in some cases led to linguistics issues or ambiguous translation, thus losing the semantics in the translated output. It was also noticed that certain worlds were un-translated, for example "Earth" The translation for Earth Aiye or Agbaye is being confused for "Earth","World" and "Planet earth",

In this evaluation, at total of 185 (single words, short phrases and long sentences) words translated by the developed system was compared to the same translation from the human expert and

analysed for any form of ambiguity, no form of mix-up and no un-translated words, the errors detected are highlighted in Table 4 and the percentage accuracy in each category is shown and the type of match. Out of the translated 185 words evaluated, 169 were correctly translated while 16 were not correctly translated. Hence the system overall translation accuracy can be calculated as:

Total number of translated words: 185

Total number of correctly translated words: 169

Number of words not correctly translated: 16

The percentage accuracy was calculated using.

$$PA_T = \frac{\text{No. of Correctly Translated Text}}{\text{Total No. of Translated Text}} \times 100\%$$

$$PA_T = \frac{169}{185} \times 100\% \quad = 91.35\% \text{ Accuracy}$$

While the Reliability of the system is

$R = 1 - \lambda_T$ which is 0.91

DATA ANALYSIS

In this stage the CL and GIE text dataset was uploaded into MS Excel file, for ease of data cleaning, and labelling of the raw data. Data cleaning was carried out on the data by removing noise from the text data, removing extra white space, removing stop words, removing punctuation, and change to lower case, stemming, lemmatization and removal of accented characters. The dataset of pairs of English sentences and their corresponding Yoruba translations was further loaded into Python and organized using the panda's library. The dataset was split into three sets: one set for training, one set for validation, and the last set for testing.

Table 4 Evaluation of the Percentage Accuracy of the CATTS (English-Yoruba Translation) System

S/N	CL and GIE keyword or Sentence in English	CATTS Translation into Yoruba	Human Translation	Any language mix-up?	Any un-translated word?	Any linguistic Issue identified?	Translation percentage (%) accuracy/Type of Match
1	Sea level	ipele okun	ipele okun	Non	Non	Non	100% Exact Match
2	Diffusion	Itankale	Itankale	Non	Non	Non	100% Exact Match
3	Climate Change	Iyipada Iju-ojo	Iyipada Iju-ojo	Non	Non	Non	100% Exact Match
4	Renewable Energy	Agbara isọdọtun	Agbara isọdọtun	Non	Non	Non	100% Exact Match
5	Rising global temperatures result in melting glaciers, rising sea levels, and more	Dide awon otutu agbaye ja si ni yo glaciers, nyara awán ipele okun, ati	Piposi iwon ootutu agbaye lo ma n fa yiyo awon yinyin, lilo soke ipele okun,	There is missed up. Yiyo, nyara,	Glacier	Lexical issue Semantic	87% , Sub-Segment Match

	frequent extreme weather events.	siwaju sii loorekoore awán isele oju ojo	ati awon isele lore kore to tayo ala isele oju-ojo	Isele	issue	
6	An awareness of the carbon dioxide cost and impacts of everyday activities and the ability and the motivation to reduce emissions	Imoye ti awon idiyele erogba oloro ati awon ipa ti awon ise ojojumo, ati agbara ati iwuri lati dinku awon uja	Imoye ti gaasi Kaboni dioxide idiyele ati ipa ise ojojumo, ati agbara ati wuri lati dinku awon itujade	There is Non missed up. erogba oloro ibujade	Non	95%, Full match

4.2 ANALYSIS OF THE SURVEY STUDY CONDUCTED

The Computer Aided Translation Teaching System (CATTS) was made available to for use by users consisting of students (undergraduate and postgraduates), academic staff across various departments and ICT experts, after which the questionnaire designed for this research was administered to the users to help analyse the users experience in terms of the application development tool, users perception of the system, the efficiency and reliability of the system and the translation efficiency of the system. A sample of the research questionnaire is shown in Appendix A.

A total of 93 respondents filled and retuned filled questionnaires. The questionnaire consists of a total of 34 questions in five categories, 12 questions are categorical questions of "Yes" or "No" type response while the other 22 questions in the questionnaire was developed on a 5-point Likert rating scale, respondents specify their level of agreement to a question or statement. Data was collected using scale 5 to represent "strongly agree" and 1 to represent "strongly disagree".

4.3 ANALYSIS OF RESPONSE

The respondent data were analysed for four (4) categories of effects namely the users' assessment on their perceptions for the system's (i) perception about Carbon literacy and GIE (ii) usability and user friendliness, (iii) relevance of the Yoruba translation system for CL and GIE and (iv) perception about the reliability and accuracy of the CAT application and the Development tools**.**

The distribution of the respondent by various categories out of the 93 respondents, 46 students, 6 Technologists, 7 Business men, 9 Lectures, 15 Computer Scientist/Engrs, 8 Civil servants/Engineers, 2 NYSC corps member.46 of the respondents are students which represent 49.5%, 6 are technologist which represent 6.5%, and 7 business men which represent 7.5% , 9 academic staff which represents 9.67%, 15 computer science experts and programmers which represent 16.1%, 8 civil servants/Engineers which represents 8.60% and 2 NYSC corps member which represents 2.15% respectively. From the spread of the respondent, about 65 to 70% of the respondents cuts across different background representing a good percentage of end user of the application, On the other hand, about 25% of the respondent are core computer programmers, technologists and engineers with different specializations to ascertain the efficiency and technical quality of the CAT application Developed.

The analysis of respondent feedback reveals that 91% of participants are aware of climate change and global warming, while 9% are unaware as shown in Figure 6a. Figure 6b revealed that 79% of respondents are familiar with the concepts of carbon literacy and greenhouse gases. While Figure 4.18 shows that 71% have knowledge of Green Innovations and Entrepreneurship. Furthermore, a significant majority (89%) concur that employing a Computer Aided Translation System for translating from English to Yoruba could enhance the teaching of Climate Change as shown in Figure 7a.

However, it is worth noting that only 76% believe that this Computer Aided Translation system can ensure a comprehensive understanding of Climate Change, Carbon Literacy, and Green Innovation in Yoruba, with 17% expressing uncertainty.

An in-depth examination of viewpoints on climate change indicates that between 54% and 84% of respondents agree that the Earth's temperature is on the rise. Moreover, 70% to 92% believe that human activities significantly contribute to climate change. Additionally, a

substantial majority (between 69% and 90%) agree that climate change is accountable for extreme occurrences such as heat waves and floods. Moreover, between 54% and 74% agree that climate change has the potential to impact biodiversity, potentially leading to species extinction. Lastly, a majority (ranging from 55% to 88%) concur that renewable energy sources play a vital role in mitigating climate change see Figure 8. Figure 9 shows users' perception about Climate Change and its effects.

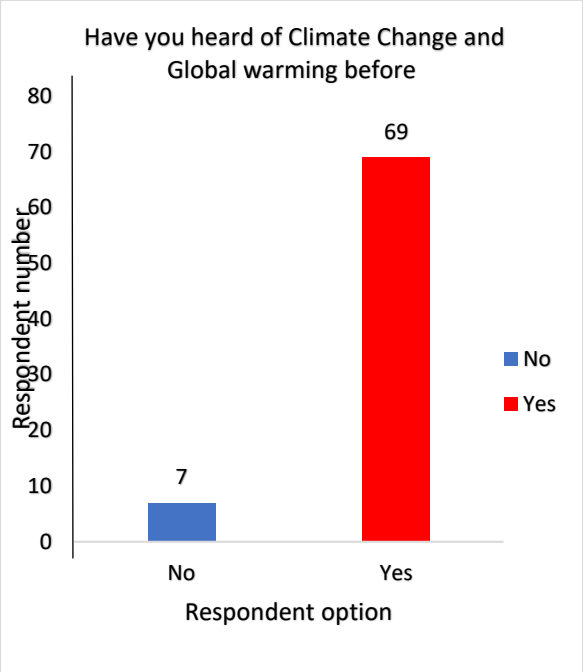


Figure 6a Climate Change and Global warming

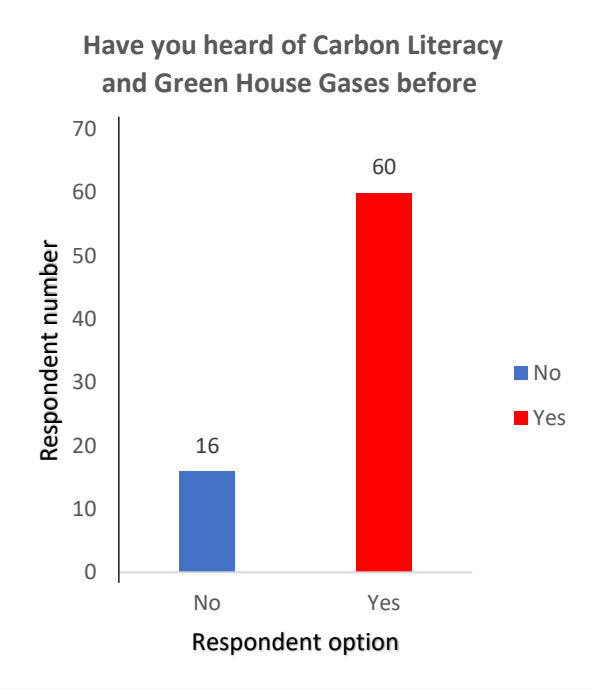
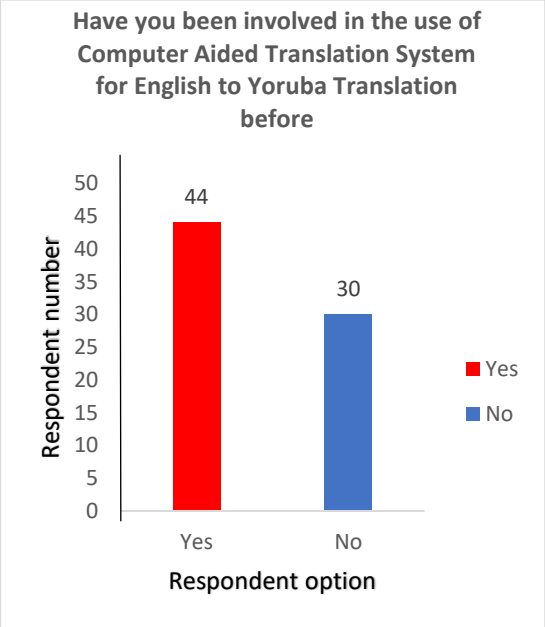


Figure 6b Carbon Literacy and Green House



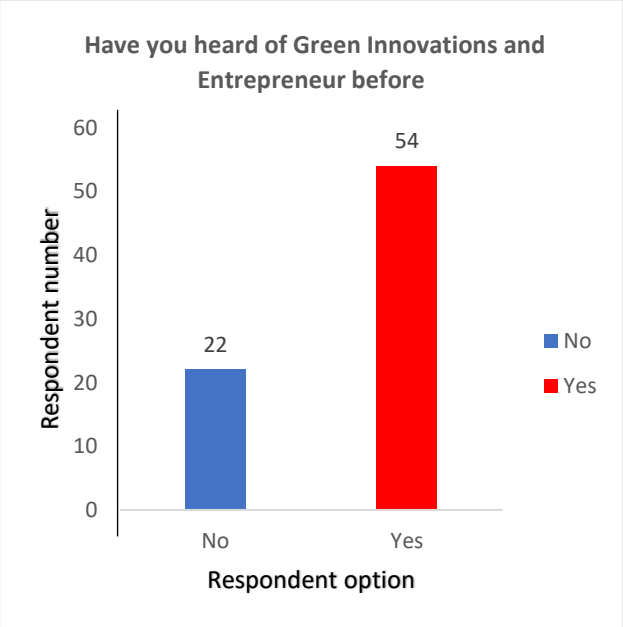


Figure 7a CAT for English to Yoruba Translation **Figure 7b Green Innovations and Entrepreneur**

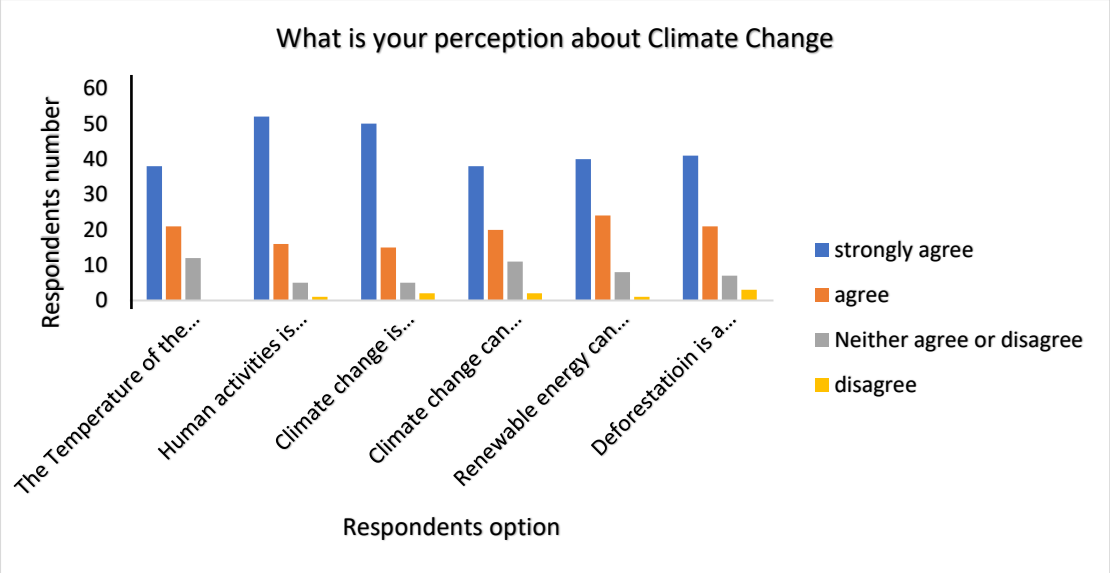


Figure 8 User perception about Climate Change and its effects

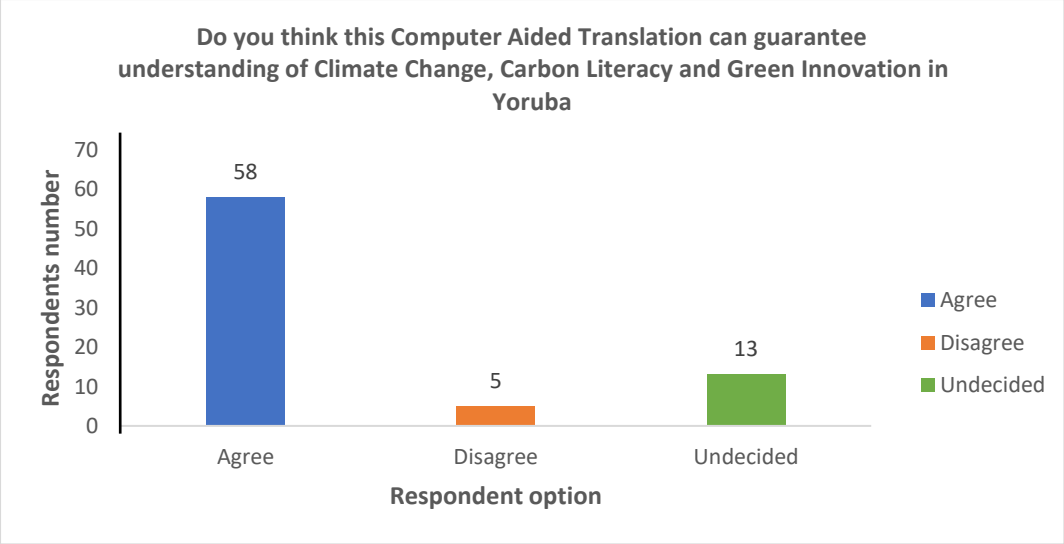


Figure 9 Guarantee of CAT in Understanding CL and GIE in Yoruba Language

The responses of the 93 respondents were analyzed and categorized into four categories that represent a measure of the respondents' understanding of Climate Change,

Carbon Literacy and Green Innovation and the adoption of computer-aided translation in understanding Climate Change, Carbon Literacy and Green Innovation.

The weighted mean score (WMS) of the 22 CL4GIE CAT based system-related questions was obtained for each question across the 93 responses and then the WMS representing each question were ranked. Statistically, since the maximum obtainable mean score is 5, then an average mean score of 2.5 is said to be positively favorable and the opinion represented by the question is accepted or on the favourable side to the respondents.

The questions were categorized into (i) distribution of the respondents by the user perception of Climate Change, Carbon Literacy and Green Innovation (ii) respondents view of employing a Computer Aided Translation System for translating from English to Yoruba (iii) the respondents view of how Computer Aided Translation system can ensure a comprehensive understanding of Climate Change, Carbon Literacy, and Green Innovation in Yoruba and (iv) respondents opinion on the challenges of use and adoption of CAT.

The four categories are shown in Tables 5 and 6. Within each category at least four or eight related questions are grouped and used in the assessment of each respondent opinion and accumulated to form the weighted mean. Table 5 is the distribution of the respondents about their perception on Climate Change, the overall table shows that the users all have good knowledge of Climate Change since all weighted mean score are more than the average of 2.5 and all have good ranking. “Climate change is responsible for extreme events such as heat waves, floods” had a WMS of 4.55 which was ranked 1st, Human activities is contributing to the change in the climate had a WMS of 4.53, the temperature of the earth is on the increase has a WMS of 4.43, Renewable energy can help in the mitigation of climate change had a WMS of 4.4, Deforestation is a contributor to carbon emission had a WMS score of 4.36.

Table 5: The distribution of the respondents by the user perception about climate change

Perception about climate change	Weighted mean score	Rank
The Temperature of the earth is on the increase	4.43	3rd
Human activities are contributing to the change in the climate	4.53	2nd
Climate change is responsible for extreme events such as heat waves, floods, etc	4.55	1st
Climate change can affect Bio0Diversity and lead to species Extinction	4.35	6th
Renewable energy can help in the mitigation of climate change	4.4	4th

Deforestation is a contributor to carbon emission	4.36	5th

Table 6: The distribution of the respondents by the user perception of Green innovation and Entrepreneur

Perception about Green Innovation and Enterpreneur?	Weighted mean score	Rank
Green Innovation is a solution to mitigate global warming	4.33	7th
Green Innovation can lead to environmental sustainability	4.4	4th
I understand the importance of sustainability in business practices	4.33	7th
I'm aware of the environmental challenges that businesses aim to address through green Innovation	4.24	11th

Table 6 shows the distribution of the respondents by the user perception of Green innovation and Entrepreneur, this category consist of four questions related to Green Innovation as solution to global warming, its relationship to environmental sustainability and its importance in business practices. It can be seen from the table that the weighted mean score of all the four questions in this category was more than 2.5 with good ranking. "Green Innovation can lead to environmental sustainability" had a WMS of 4.4 and was ranked 4th.

Green Innovation is a solution to mitigate global warming with WMS of 4.33 with a very good I understand the importance of sustainability in business practices with WMS of 4.33 from all respondents.

Conclusion

In view of the looming danger posed by global warning and the effects of climate change to the world, it therefore requires immediate action and commitments from individuals, communities and organisations in spreading the awareness of human activities that are contributing to the increase of global warming and how to reduce or mitigate the continuous emission of greenhouse gases into the atmosphere. Giving the driveable benefits inherent in the instructional design learning materials on CL and GIE translated into Yoruba language and the CATLS developed in this work for translating and teaching Climate Change Literacy (CCL), it is recommended that :

i. the instructional design learning materials on CL and GIE translated in Yoruba language and the CATLS developed be adopted for use for educational awareness, and awareness champagne by individuals, educational institutions, governmental and non-governmental organizations in Nigeria

ii. It should be developed into a comprehensive curriculum be integrated into environmental awareness teaching in Yoruba language.

This will become part of Nigerian's commitment to the United Nations Frameworks Convection on Climate Change (UNFCCC) goal of combating climate change through education and partly achieving the Paris agreement towards the global net zero carbon and global temperature limit of 1.5^{o}C goal of the United Nations (UN) Climate Change Conference (COP26).

5. ACKNOWLEDGMENTS

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