Journal of Humanities and Social Sciences Studies
ISSN: 2663-7197
DOI: 10.32996/jhsss
Journal Homepage: www.al-kindipublisher.com/index.php/jhsss

JHSSS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Designing Culturally Responsive Visual Aids for Health Education in Managing Chronic Lifestyle Conditions in Ghana

Isaac Agyei Annor[1], Adam Rahman[2], Ralitsa Diana Debrah[3] and Kofi Nyame Amoako-Agyeman[4] ✉
[1234]Department of Communication Design, College of Art and Built Environment, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana
Corresponding Author: Kofi Nyame Amoako-Agyeman, **E-mail**: knaagyeman.cass@knust.edu.gh

| ABSTRACT
This study explored the potential of culturally adapted visual health education materials in supporting adults with diabetes and hypertension in Ghana. Limited health literacy and cultural barriers often make it difficult for individuals to manage these conditions effectively. To address this, a randomized controlled trial was conducted with 50 participants aged 40–81 years, most of whom were women. Participants were assigned either to a control group that received traditional health education or to an intervention group that used culturally adapted visual materials designed with African cultural elements and supported by AI-generated prompts. The materials focused on five self-management areas: nutrition, physical activity, medication adherence, healthcare engagement, and protein intake. Results showed that while both groups achieved similar immediate knowledge gains, those in the intervention group maintained significantly higher knowledge retention and self-efficacy after three months. Women demonstrated particularly strong retention, and participants with hypertension showed the greatest improvements. These findings suggest that culturally adapted visual aids for education can improve long-term outcomes for individuals with limited baseline knowledge, offering a promising approach to reducing health disparities. The integration of artificial intelligence into cultural adaptation provides a scalable model for developing effective health communication tools.

| KEYWORDS
Culturally Responsive Visual Aids, Health literacy, Diabetes, Hypertension, Artificial Intelligence in Health Communication, Patient education, Ghanaian Healthcare

| ARTICLE INFORMATION

ACCEPTED: 12 January 2025 **PUBLISHED:** 30 January 2025 **DOI:** 10.32996/jhsss.2025.7.1.8

1. Introduction

Clear communication between healthcare providers and patients is essential for effective treatment and positive health outcomes. During hospital discharge, patients receive critical information about their conditions, medications, and follow-up care, yet many struggle to fully understand or remember these instructions. This gap often leads to medication non-adherence, treatment errors, and preventable hospital readmissions, which place significant financial and health burdens on individuals and healthcare systems (Okuyama et al., 2014; Alper et al., 2018).

Visual communication aids such as diagrams, infographics, videos, and interactive models, offer a powerful way to bridge this gap. Patients often prefer visual tools because they simplify complex information, improve recall, reduce anxiety, and strengthen engagement with their care (Townsend, 2011; Pratt & Searles, 2017). Evidence shows that integrating visual aids into consultations enhances comprehension, supports decision-making, and empowers patients to manage their conditions more effectively (Hersh et al., 2015; Yeung et al., 2017).

Despite these benefits, visual aids remain underutilized in many clinical settings, especially in low-and middle-income countries such as Ghana. Limited resources and health literacy challenges make it even more important to adopt communication strategies that resonate with patients and support long-term disease management (Nutbeam, 2000; Abel & Benkert, 2022; Sarkodie, 2021; Debrah, 2021). This study responds to this need by evaluating how culturally adapted visual communication aids can improve comprehension and recall of discharge instructions among patients with hypertension and diabetes.

2. Literature Review

2.1 Visual Communication Aids in Healthcare

Visual communication in healthcare has progressed from basic anatomical sketches to culturally tailored educational tools. Early evidence from Houts et al. (2006) showed that visuals significantly improve attention, comprehension, recall, and adherence across diverse patient groups. Since then, systematic reviews have confirmed that visual interventions consistently outperform text-only materials in enhancing understanding and memory. Galmarini et al. (2024a) highlighted that visual aids are particularly effective for patients with low health literacy, while Lee and Nathan-Roberts (2021) found that simple, large, and culturally relevant visuals produce the greatest improvements.

2.2 Cultural Adaptation in Patient Education

Cultural relevance plays a crucial role in how patients respond to health information. Castro et al. (2010) demonstrated that materials incorporating traditional narratives and symbols achieve higher acceptance than generic content. In African contexts, Dowse and Ehlers (2001) reported stronger engagement with visuals rooted in local traditions. More recently, the Community Health Advocacy Teams (CHAT) in Ghana achieved significant knowledge and behavior change through co-created, context-specific communication strategies (Glozah et al., 2024). These findings emphasize the importance of embedding health education within cultural frameworks.

2.3 Cognitive and Learning Theories

Several theories explain why visuals are powerful in health education. Paivio's dual coding theory (1986) shows that information processed simultaneously through verbal and visual channels enhances recall. Mayer's (2001) multimedia learning principles stress the need for coherent, focused, and well-aligned designs to reduce overload. Cognitive load theory (Sweller, 1988) further suggests that visuals reduce unnecessary mental strain, freeing patients to focus on essential health information. Research on the picture superiority effect (Standing, 1973) demonstrates that images are inherently more memorable than words, particularly when they are culturally familiar. The Health Belief Model (Rosenstock, 1974) explains how visuals can influence perceptions of risk, benefits, and self-efficacy, driving behavior change.

2.4 Visual Aids in Chronic Disease Management

Chronic conditions such as diabetes and hypertension demand consistent self-management. Studies show that illustrated instructions improve medication adherence and long-term knowledge retention compared to text-only formats (Michielutte et al., 1992; Garcia-Retamero & Cokely, 2013). Digital and interactive visual tools have also been linked to greater engagement and better clinical outcomes (Smith et al., 2017). These findings underscore the promise of visual communication in supporting long-term disease management.

2.5 Barriers and Emerging Opportunities

Despite proven benefits, implementation remains uneven. Limited infrastructure, cost constraints, and cultural resistance can restrict the use of visuals in low-resource settings (Jha et al., 2009; Frazier et al., 2023). Language diversity also requires visuals to be designed for universal comprehension (Reilly et al., 2023). However, advances in mobile health and artificial intelligence are expanding opportunities. Apps with visual reminders improve adherence (Hartch et al., 2023), and AI tools now offer scalable ways to generate culturally sensitive visual content (Dwivedi et al., 2023).

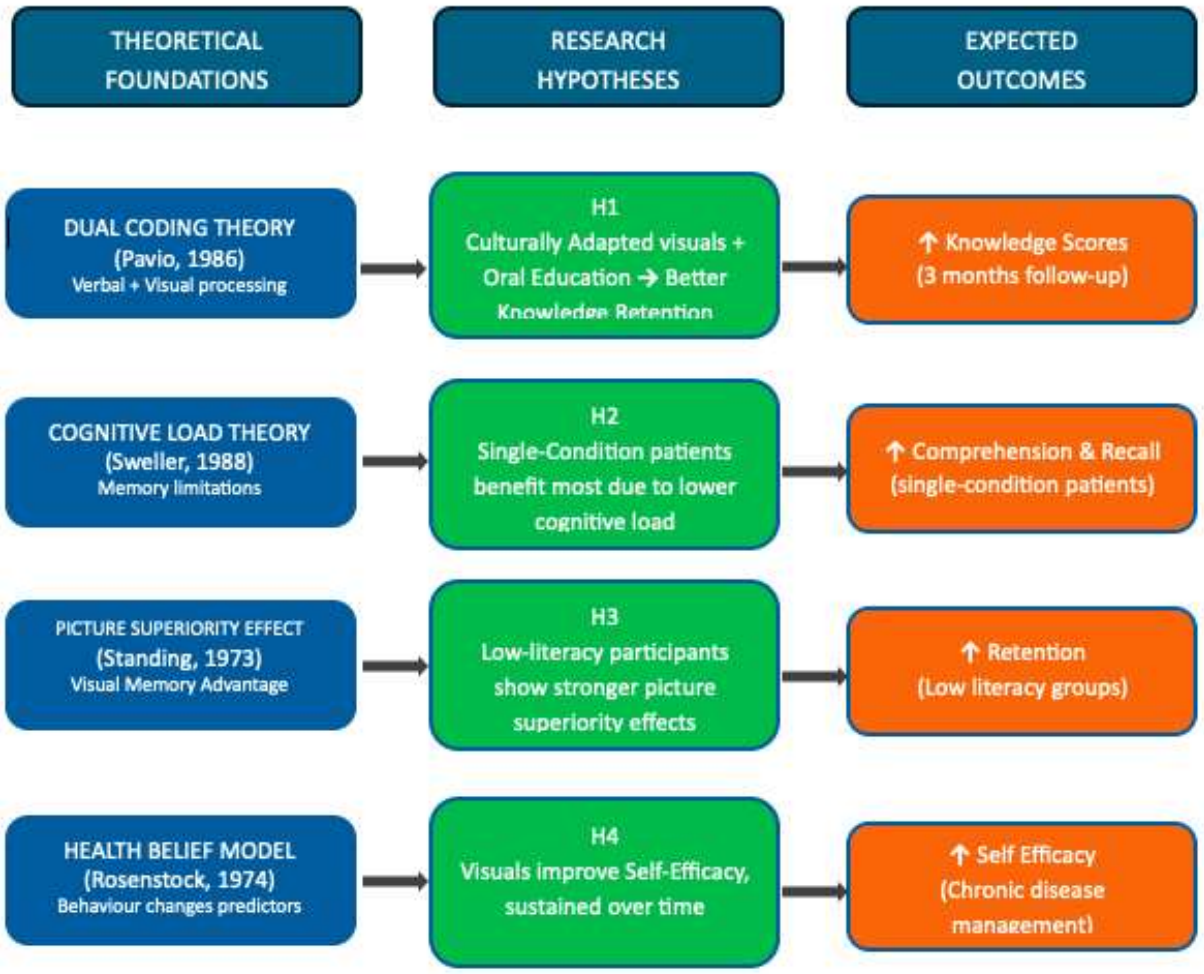

Figure 1: Theoretical Framework for Visual Communication in Healthcare

2.5.1 Hypotheses

Drawing on this body of research, the study proposes four hypotheses:

1. Patients receiving culturally adapted visual communication aids with oral education will demonstrate better knowledge retention after three months compared to those receiving oral education alone.
2. Visual communication will be most effective for patients managing a single chronic condition, as lower cognitive load allows for more efficient processing.
3. The picture superiority effect will benefit participants with limited formal education, who may rely more on visual cues than written text.
4. Patients exposed to culturally adapted visual aids will report stronger self-efficacy in managing their conditions, with effects sustained over time.

These hypotheses provide the foundation for the study's methods, which test how culturally adapted visual aids compare to traditional education in supporting knowledge retention and self-efficacy among patients with diabetes and hypertension in Ghana (See Figure 1 and Table 1).

Table 1: Study Hypotheses and Theoretical Foundations

Hypothesis	Theoretical Basis	Prediction	Expected Outcome
H1: Patients receiving culturally adapted visual communication aids alongside oral education will show greater knowledge retention at three-month follow-up than those receiving oral education alone.	Dual Coding Theory (Paivio, 1986)	Engaging both verbal and visual pathways enhances memory.	Higher knowledge scores in intervention group at follow-up.
H2: Visual communication aids will be most effective for patients managing a single chronic condition compared to those with multiple conditions.	Cognitive Load Theory (Sweller, 1988)	Lower intrinsic load allows patients to process educational materials more effectively.	Greater comprehension and recall among single-condition patients.
H3: The picture superiority effect will be more pronounced among participants with limited formal education.	Picture Superiority Effect (Standing, 1973; Paivio & Csapo, 1973)	Images bypass literacy barriers and are more memorable than text.	Improved retention among low-literacy participants using visual aids.
H4: Patients exposed to culturally adapted visual communication aids will demonstrate higher self-efficacy in managing their conditions, sustained at three-month follow-up.	Health Belief Model (Rosenstock, 1974)	Visuals influence perceptions of risk, benefits, and build confidence for action.	Greater self-efficacy scores in intervention group compared to controls.

3. Methods

3.1 Study Design

This study employed a randomized controlled trial (RCT), specifically a parallel-group, single-blind design with follow-up assessments. An RCT was chosen as the most rigorous approach to determine whether visual communication aids improve patient outcomes compared to traditional verbal discharge education.

3.2 Study Setting and Population

The study was conducted at a hospital in Kumasi, Ashanti Region, Ghana. Participants were outpatients or recently discharged patients aged 40 years and above with a diagnosis of hypertension and/or diabetes. Eligible participants represented a diverse range of demographic backgrounds and were required to have stable medical conditions, ongoing care at the facility, and the ability to provide informed consent.

3.3 Sample Size and Sampling

Sample size was calculated using the formula for comparing two independent means in RCTs. Parameters included: significance level ($\alpha = 0.05$), power (80%), effect size (Cohen's $d = 0.91$), expected mean difference of 1.36 on a 9-point knowledge scale, and an estimated standard deviation of 1.5. A total of 50 participants (25 per group) was determined to provide sufficient power while accounting for attrition. Participants were selected through simple random sampling and enrolled after providing consent.

3.4 Measures

- **Knowledge Retention:** Assessed with a standardized 9-item scale covering key aspects of diabetes and hypertension management (diet, physical activity, medication adherence, healthcare engagement, protein intake). Higher scores indicated greater knowledge.
- **Self-Efficacy:** Measured using validated rating scales that captured confidence in managing diet, medication use, physical activity, and follow-up care.
- **Sociodemographic and Clinical Data:** Age, gender, education level, type of chronic condition (hypertension only, diabetes only, or both), and other relevant clinical information were collected to allow subgroup analyses.

3.5 Data Collection

A structured questionnaire was administered at three time points: baseline (pre-test), immediately after discharge education (post-test), and at three-month follow-up (recall). Knowledge and self-efficacy scores were compared across these intervals to evaluate both short-term learning and long-term retention.

3.6 Development of Visual Aids

A design-led methodology guided the creation of culturally adapted visual materials:

- **Phase 1:** AI-generated prompts inspired initial sketch concepts incorporating local foods (kontomire, garden eggs, oranges, pawpaw) and familiar cultural contexts.
- **Phase 2:** Hand-drawn sketches were digitally enhanced in Adobe Photoshop, integrated with text in Adobe Illustrator, and formatted into A3-sized printable PDFs.
- **Phase 3:** Draft visuals were reviewed by physicians, nurses, pharmacists, and a dietitian to ensure medical accuracy and cultural appropriateness. Feedback from patients and community members further refined the materials.

3.7 Intervention Protocol

Participants were randomly assigned to either the control group (n = 25) or the intervention group (n = 25). Both groups received standard oral discharge education covering disease management, lifestyle modification, and medication adherence. In addition, the intervention group was shown the culturally adapted visual aids developed for the study.

3.8 Data Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics 25. Descriptive statistics summarized baseline demographics and clinical characteristics. Independent samples t-tests compared group differences at each time point, while repeated measures analyses examined changes over time. Effect sizes (Cohen's d) assessed the practical significance of findings. Stratified analyses were conducted to explore whether demographic factors such as gender and education influenced intervention outcomes.

3.9 Ethical Considerations

Ethical approval for this study was obtained from the Kwame Nkrumah University of Science and Technology (KNUST) Ethical Review Board as well as the ethics committee of the participating hospital. A formal letter of introduction was provided by the Department of Communication Design, College of Arts and Built Environment, KNUST, to facilitate participant recruitment and engagement.

Prior to participation, written informed consent was obtained from all participants after a detailed explanation of the study's purpose, procedures, potential risks, and benefits. To ensure confidentiality, all data were anonymized and securely stored in locked cabinets and password-protected electronic files, accessible only to the research team.

4. Results

4.1 Study Population

The study targeted adults aged 40 years and older diagnosed with diabetes and/or hypertension. Of the 60 patients invited, 52 agreed to participate, and 50 successfully completed the baseline assessment and were randomly assigned to one of two groups. This high participation rate supported reliable analysis of knowledge and self-efficacy over time.

4.2 Demographic Characteristics

Table 2 presents demographic characteristics of the two groups. The control group (Group A) had a mean age of 59.5 years, slightly older than the intervention group's 55.4 years, though the difference was not clinically meaningful. Both groups ranged from 40 to over 80 years of age. Gender distribution was identical, with 84% female and 16% male in each group, reflecting successful randomization.

Table 2. Demographic Characteristics by Group (Source: Field study 2024)

Variable	Group A (n=25)	Group B (n=25)
Age, years		
Mean (SD)	59.5 (10.3)	55.4 (11.6)
Range	40-76	40-81
Gender, n (%)		
Male	4 (16.0)	4 (16.0)
Female	21 (84.0)	21 (84.0)

4.3 Educational Level

Differences emerged in educational attainment (Table 3). The control group included more participants with no formal education (40%) compared to 20% in the intervention group. In contrast, the intervention group showed a broader spread, with higher representation at the primary, secondary, and high school levels. Only one participant in the control group reported tertiary education. These differences highlight the role of literacy in interpreting health education interventions.

Table 3. Educational Level Distribution (Source: Field study 2024)

Educational Level	**Group A n (%)**	**Group B n (%)**
No Formal Education	10 (40.0)	5 (20.0)
Primary	2 (8.0)	6 (24.0)
Secondary (JHS)	12 (48.0)	10 (40.0)
High School (SHS)	0 (0.0)	4 (16.0)
Tertiary	1 (4.0)	0 (0.0)

4.4 Clinical Characteristics

Clinical profiles are summarized in Table 4. Both groups presented with considerable metabolic burden, with mean BMI values above 30 kg/m^2, indicating obesity was common across participants. Average systolic blood pressure was slightly higher in the control group (145.4 mmHg vs. 139.8 mmHg), while fasting blood sugar levels were elevated in both groups, particularly in the control group. The distribution of conditions showed hypertension as the most prevalent, while nearly half of participants in both groups were managing both diabetes and hypertension.

Table 4. Clinical Characteristics (Source: Field study 2024)

Parameter	**Group A**	**Group B**
BMI (kg/m^2)		
Mean (SD)	30.5 (8.6)	31.7 (6.8)
Range	22.0-62.6	22.6-46.5
Systolic BP (mmHg)		
Mean (SD)	145.4 (20.6)	139.8 (17.8)
Diastolic BP (mmHg)		
Mean (SD)	83.4 (25.2)	82.1 (9.4)
Fasting Blood Sugar (mmol/L)		
Mean (SD)	8.3 (4.6)	7.0 (2.0)
Condition Distribution, n (%)		
Diabetes only	2 (8.0)	1 (4.0)
Hypertension only	14 (56.0)	12 (48.0)
Both conditions	9 (36.0)	12 (48.0)

4.5 Development of Visual Aids

The creation of culturally adapted visual aids followed a structured design process. Initial concept ideas were generated using AI prompts that incorporated traditional Ghanaian cultural elements such as local foods (kontomire, garden eggs, tomatoes, pawpaw) and familiar social contexts. These concepts were refined into hand-drawn sketches and digitally enhanced using Photoshop. The final illustrations are presented as clear "Do's and Don'ts" across five key self-management domains (See Figures 2, 3 and 4):

1. Dietary practices (increasing fruits and vegetables, reducing salt and sugar)
2. Physical activity participation
3. Routine health monitoring
4. Medication adherence
5. Lifestyle modifications (avoiding alcohol, tobacco, and prolonged inactivity)

Additional materials emphasized complication awareness, visually communicating the potential consequences of poor disease management. These culturally embedded designs provided an accessible medium for participants with different literacy levels, ensuring practical relevance for diabetes and hypertension education.

4.5.1 DO's

Figure 2A (Left): Vegetable and Fruit Consumption

Figure 2B (Right): A man drinking water with cups on the table

4.5.2 DON'Ts

Figure 3A (Left): A man holding a bottle of soda

Figure 3B (Right): A plate full of fries and fatty foods

(Source: Authors' own construct, 2024).

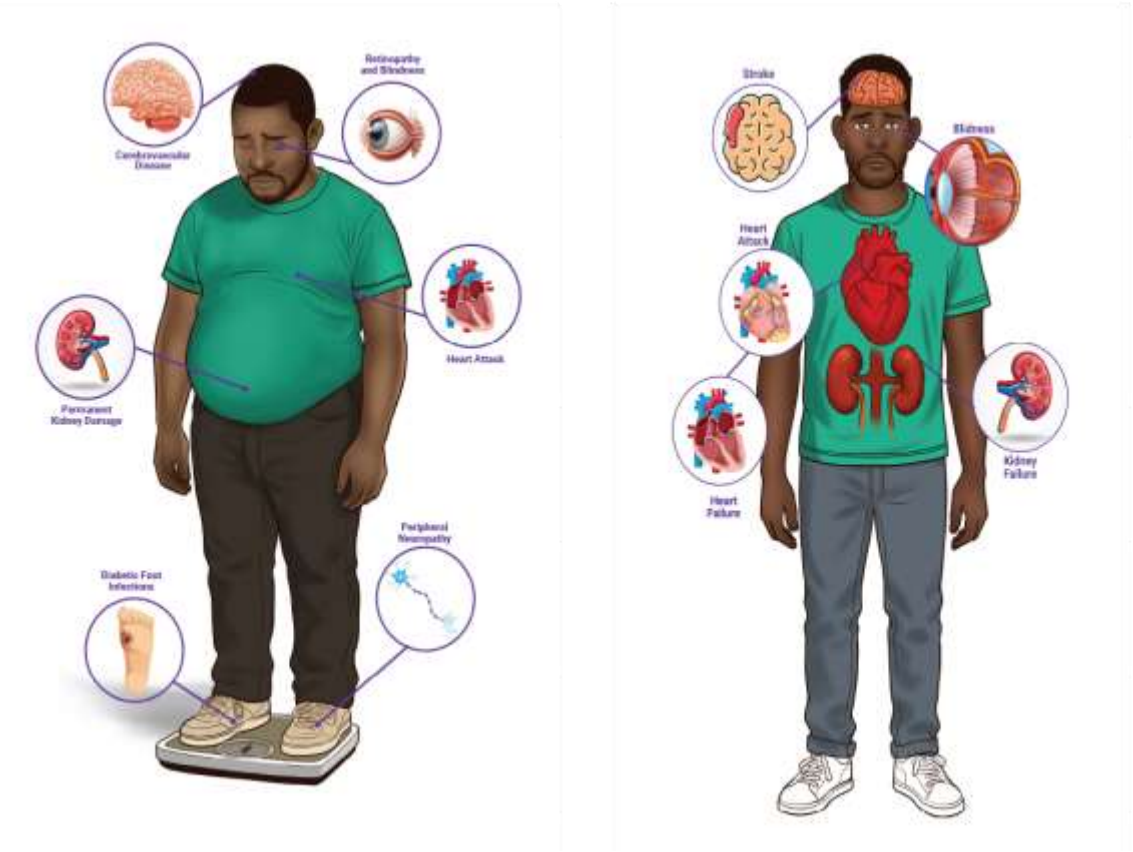

Figure 4: A picture of two male patients showing complications associated with diabetes management (Source: Authors' own construct, 2024)

4.6 Results

4.6.1 Primary Outcomes

4.6.1.1 Knowledge Scores

Table 5 summarizes changes in knowledge across groups. At baseline, the control group scored significantly higher than the intervention group (4.20 vs. 2.84, p = 0.006), with a moderate-to-large effect size (Cohen's d = 0.70). Despite this initial disadvantage, the intervention group rapidly closed the gap. Immediately after the intervention, both groups achieved similar post-test scores (6.88 vs. 6.48, p = 0.234), indicating that participants in both arms had comparable short-term learning capacity.

At three months, however, retention patterns diverged. The intervention group maintained stronger knowledge scores (7.12 vs. 6.28, p = 0.025; d = –0.59), suggesting that culturally adapted visual aids supported more durable learning over time. While traditional oral instruction was effective for immediate gains, the addition of visual materials enhanced long-term consolidation.

Table 5. Knowledge Scores by Group (Source: Field study 2024)

Assessment	**Group A**	**Group B**	**Between-Group**	**Effect**	**p-value**
	Mean (SD)	**Mean (SD)**	**Difference**	**Size (d)**	
Pre-test (max 9)	4.20 (1.91)	2.84 (1.99)	1.36	0.70	**p = 0.006**
Post-test	6.88 (1.42)	6.48 (0.77)	0.40	0.34	p = 0.234
Recall (3 month)	6.28 (1.62)	7.12 (1.17)	-0.84	-0.59	**p = 0.025**

4.7 Self-Efficacy

Patterns in self-efficacy mirrored knowledge gains but revealed additional psychological insights (Table 6). The control group began with greater confidence (3.08 vs. 2.44, p = 0.021), consistent with their higher baseline knowledge. Both groups improved significantly post-intervention, with the intervention group showing a trend toward higher self-efficacy (4.72 vs. 4.36, p = 0.067).

At the three-month recall, the intervention group sustained their improvement (4.76), while the control group declined slightly (4.04). The difference was statistically significant (p = 0.001), demonstrating that visual communication aids not only supported knowledge retention but also helped participants sustain confidence in managing their conditions.

Table 6. Self-Efficacy Scores by Group (Source: Field study 2024)

Assessment	**Group A**	**Group B**	**Mean Difference**	**p-value**
	Mean (SD)	**Mean (SD)**		
Baseline	3.08 (0.91)	2.44 (0.87)	0.64	**p = 0.021**
Post-intervention	4.36 (0.70)	4.72 (0.46)	-0.36	p = 0.067
Three-month recall	4.04 (0.73)	4.76 (0.44)	-0.72	**p = 0.001**

4.8 Secondary outcomes

4.8.1 Gender and Knowledge Outcomes

Gender-stratified analysis revealed distinct learning trajectories (Table 7). At baseline, males demonstrated higher knowledge scores than females (4.38 vs. 3.36). After the intervention, scores converged, with both genders achieving nearly identical post-test results. At three months, however, females retained more information (6.81 vs. 6.13), reversing the initial male advantage. This suggests that women may benefit more from culturally adapted visual aids in sustaining long-term learning.

Table 7. Gender and Knowledge Outcomes (Source: Field study 2024)

Time Point	Males (n=8)	Females (n=42)	Difference (M-F)
Pre-test	4.38 (±1.30)	3.36 (±1.59)	+1.02
Post-test	6.75 (±1.49)	6.67 (±1.24)	+0.08
Recall	6.13 (±1.46)	6.81 (±1.13)	-0.68

4.9 Medical Condition and Knowledge Outcomes

Condition-specific outcomes are presented in Table 8. Participants with diabetes only (n = 3) began with the highest baseline knowledge (4.67), likely reflecting the intensive self-management demands of diabetes. Despite their small sample size, this subgroup demonstrated strong improvements post-test and sustained recall.

The hypertension-only group (n = 26) started with the lowest knowledge (3.15) but achieved substantial improvements after intervention (6.73) and maintained them at recall (6.77). Participants managing both conditions (n = 21) showed intermediate baseline scores and steady, though more modest, improvements over time. These findings suggest that intervention benefits extend across conditions, with particularly strong gains for participants managing hypertension alone.

Table 8. Knowledge Outcomes by Medical Condition (Source: Field study 2024)

Condition	n	Pre-test	Post-test	Recall
Diabetes only	3	4.67 (±1.53)	7.33 (±1.53)	7.00 (±1.00)
Hypertension only	26	3.15 (±1.64)	6.73 (±1.31)	6.77 (±1.21)
Both conditions	21	3.81 (±1.44)	6.52 (±1.21)	6.57 (±1.25)

5. Discussion

5.1 Effectiveness of Visual Communication Aids: Theoretical Alignment

The study demonstrates that culturally adapted visual aids significantly enhanced knowledge retention and confidence in self-care among patients with diabetes and hypertension. At three months, participants exposed to visual materials outperformed those who received only verbal instruction (7.12 vs. 6.28, p = 0.025). This finding strongly aligns with Paivio's dual coding theory (1986), which argues that engaging both visual and auditory channels enhances memory formation.

The fact that the intervention group began with lower baseline knowledge (2.84 vs. 4.20, p = 0.006) yet retained more information at follow-up underscores the picture superiority effect described by Standing (1973) and supported in healthcare by Houts et al. (2006). Immediate post-intervention scores converged across groups, but longer-term divergence favors the

intervention, reinforcing Mayer's (2001) cognitive load theory. Visual aids likely reduced extraneous cognitive load, enabling patients with less prior knowledge to learn effectively and consolidate information over time.

5.2 Cultural Adaptation and Community Engagement

Designing the materials around local foods, familiar settings, and culturally resonant scenarios proved critical. This process reflects participatory approaches highlighted in community-based participatory research (Israel et al., 2012) and Participatory Rural Appraisal methods. The incorporation of traditional elements such as kontomire (cocoyam leaves), garden eggs, and everyday cooking practices echoes Castro et al.'s (2010) findings that culturally embedded health education materials foster greater acceptance and effectiveness. These results reinforce the argument that cultural adaptation is not an optional enhancement but a necessary component of equitable health communication.

5.3 Self-Efficacy Improvements

Sustained improvements in self-efficacy among the intervention group (4.76 vs. 4.04, p = 0.001) align with the Health Belief Model (Rosenstock, 1974; Skinner et al., 2015). Visual aids addressed several components of the model simultaneously. Illustrations of symptoms and complications likely increased perceptions of susceptibility and severity, while step-by-step depictions of self-care behaviors reduced perceived barriers. Representations of successful disease management may also have strengthened self-efficacy beliefs, which are critical for initiating and maintaining health behavior change.

5.4 Disease-Specific Learning Patterns

Condition-specific findings highlight the role of cognitive burden in shaping learning outcomes. Participants managing both diabetes and hypertension showed more modest improvements than those with a single condition, despite receiving the same intervention. This pattern supports Sweller's (1988) cognitive load theory, which emphasizes that intrinsic cognitive load rises with task complexity. Managing two chronic conditions simultaneously may limit patients' ability to process and retain new health information. These results suggest that tailored interventions may be needed for individuals facing higher disease burdens.

5.5 Limitations

Differences in educational attainment between groups created natural variation that enriched analysis but also introduced potential confounding factors. The modest sample size (n = 50) and single-site design restrict the extent to which findings can be generalized to broader populations. In addition, the three-month follow-up period, while sufficient for assessing short-term retention, does not capture long-term behavioral change or clinical outcomes. Larger, multi-site studies with extended follow-up are needed to confirm and expand on these results.

5.6 Future Research

Further work should extend beyond short-term outcomes to explore how culturally adapted visual aids influence long-term disease management, treatment adherence, and clinical markers such as blood pressure and glucose control. Multi-site studies across diverse regions of Ghana and other low- and middle-income countries would enhance generalizability and reveal how cultural adaptation strategies vary across contexts. Future research should also test digital and mobile-based delivery of visual materials, assessing how technology, including AI-driven personalization can expand access, reduce costs, and support patients with varying literacy levels. Mixed-method approaches combining quantitative assessments with in-depth qualitative insights could provide a richer understanding of how patients engage with and apply visual health education in daily life.

6. Conclusions

This study demonstrates that culturally adapted visual communication aids can improve both knowledge retention and self-efficacy among adults living with diabetes and hypertension in Ghana. While both oral and visual-augmented methods supported immediate learning, participants who received visual materials sustained their knowledge and confidence more effectively over time.

These findings challenge the conventional reliance on immediate post-intervention assessments as the primary marker of success in health education. Long-term retention and self-efficacy may be more meaningful indicators of real-world impact. The fact that participants with lower baseline knowledge achieved superior retention after exposure to visual aids highlights the importance of culturally grounded design in reducing disparities.

The results align with dual coding theory by showing that combining verbal and visual channels strengthens memory, and with the Health Belief Model by illustrating how visuals can build confidence in disease self-management. Importantly, culturally

relevant visual strategies empowered patients by connecting medical advice to everyday foods, practices, and symbols that resonated with their lived experiences.

6.1 Implications for Policy and Practice

The outcomes of this study carry important implications for healthcare professionals and policymakers:

1. **Prioritize culturally responsive design:** Visual materials adapted to local traditions, foods, and practices can promote long-term learning and confidence, particularly among patients with limited health literacy. Allocating resources to culturally tailored materials may yield more sustainable benefits than short-term information delivery.
2. **Leverage technology for scale:** The success of AI-assisted cultural adaptation suggests that technology can support the development of culturally relevant educational tools at scale, offering an efficient complement to resource-intensive participatory design methods in low-resource settings.
3. **Tailor approaches to patient subgroups:** Variations across gender and condition-specific groups indicate that personalized educational strategies may optimize outcomes. Policies that encourage flexible, adaptive health education approaches will be more responsive to diverse patient needs.

In summary, by focusing on interventions that build both knowledge and confidence, health systems, especially in resource-limited contexts can strengthen chronic disease management and reduce health disparities.

Acknowledgments: The authors express sincere gratitude to all who contributed to this research. Special thanks to the Maternal and Child Health Hospital, Kumasi, for granting approval to use the facility as a study site, and to Dr. Henry Ataburo for his valuable guidance and input throughout the study.

Funding: This research received no external funding

Conflicts of Interest: The authors declare no conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors, and the reviewers.

References

[1] Abel, T. & Benkert, R., (2022). Critical health literacy: reflection and action for health. *Health Promotion International*, 37(4), p.daac114. https://doi.org/10.1093/heapro/daac114

[2] Alper, E., O'Malley, T.A. & Greenwald, J., (2018). Hospital discharge and readmission. In: J. Halpern & C. Goldberger, eds. *Hospital Medicine*. 3rd ed. Philadelphia: Elsevier, pp. 919–926.

[3] Castro, F.G., Barrera, M. & Holleran Steiker, L.K., (2010). Issues and challenges in the design of culturally adapted evidence-based interventions. *Annual Review of Clinical Psychology*, 6, pp.213–239. https://doi.org/10.1146/annurev-clinpsy-033109-132032

[4] Debrah, R. D. (2021). *Design for health: Designing health information services in the Afrikan context* (PhD thesis). Cape Peninsula University of Technology.

[5] Hersh, L., Salzman, B. & Snyderman, D., (2015). Health literacy in primary care practice. *American Family Physician*, 92(2), pp.118–124. Available at: https://www.aafp.org/pubs/afp/issues/2015/0715/p118.html

[6] Houts, P.S., Doak, C.C., Doak, L.G. & Loscalzo, M.J., (2006). The role of pictures in improving health communication: A review of research on attention, comprehension, recall, and adherence. *Patient Education and Counseling*, 61(2), pp.173–190. https://doi.org/10.1016/j.pec.2005.05.004

[7] Israel, B.A., Eng, E., Schulz, A.J. & Parker, E.A., (2012). *Methods for community-based participatory research for health*. 2nd ed. San Francisco: Jossey-Bass/Wiley.

[8] Lu, B. & Hanim, R.N., (2024). Enhancing learning experiences through interactive visual communication design in online education. *Eurasian Journal of Educational Research*, 109, pp.134–157. https://doi.org/10.14689/ejer.2024.109.009

[9] Mayer, R.E., (2001). *Multimedia learning*. Cambridge: Cambridge University Press.

[10] Nutbeam, D., (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), pp.259–267. https://doi.org/10.1093/heapro/15.3.259

[11] Okuyama, A., Wagner, C. & Bijnen, B., (2014). Speaking up for patient safety among hospital-based health care professionals: A literature review. *BMC Health Services Research*, 14(1), p.61. https://doi.org/10.1186/1472-6963-14-61

[12] Paivio, A., (1986). *Mental representations: A dual coding approach*. Oxford: Oxford University Press.

[13] Pratt, M. & Searles, G.E., (2017). Using visual aids to enhance physician–patient discussions and increase health literacy. *Journal of Cutaneous Medicine and Surgery*, 21(6), pp.497–501. https://doi.org/10.1177/1203475417715208

[14] Rosenstock, I.M., (1974). The health belief model and preventive health behavior. *Health Education Monographs*, 2(4), pp.354–386.

[15] Rosenthal, R., (1979). *Experimenter effects in behavioral research*. Enlarged ed. New York: Irvington Publishers.

[16] Sarkodie, A.O., (2021). Effect of the National Health Insurance Scheme on healthcare utilization and out-of-pocket payment: Evidence from GLSS 7. *Humanities and Social Sciences Communications*, 8(1), pp.1–10. https://doi.org/10.1057/s41599-021-00984-7

[17] Skinner, C.S., Tiro, J. & Champion, V.L., (2015). The Health Belief Model. In: K. Glanz, B.K. Rimer & K. Viswanath, eds. *Health behavior: Theory, research, and practice*. 5th ed. San Francisco: Jossey-Bass, pp.75–94.

[18] Standing, L., (1973). Learning 10,000 pictures. *Quarterly Journal of Experimental Psychology*, 25(2), pp.207–222. https://doi.org/10.1080/14640747308400340

[19] Sweller, J., (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), pp.257–285. https://doi.org/10.1207/s15516709cog1202_4

[20] Townsend, M.S., (2011). Patient-driven education materials: Low-literate adults increase understanding of health messages and improve compliance. *Nursing Clinics of North America*, 46(3), pp.367–378. https://doi.org/10.1016/j.cnur.2011.05.011

[21] Van Merriënboer, J.J.G. & Sweller, J., (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review*, 17(2), pp.147–177. https://doi.org/10.1007/s10648-005-3951-0

[22] Yeung, D.L., Alvarez, K.S., Quinones, M.E., Clark, C.A., Oliver, G.H., Alvarez, C.A. & Jaiyeola, A.O., (2017). Low–health literacy flashcards and mobile video reinforcement to improve medication adherence in patients on oral diabetes, heart failure, and hypertension medications. *Journal of the American Pharmacists Association*, 57(1), pp.30–37. https://doi.org/10.1016/j.japh.2016.08.012