

Assessing the Integration of QR codes in Extension Outreach Communication Graphics: A Visual Content Analysis

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Assessing the Integration of QR codes in Extension Outreach Communication Graphics: A Visual Content Analysis

Abstract

The purpose of this study was to assess the integration of Quick Response (QR) codes in extension outreach communication graphics with the aim of enhancing extension engagement and information dissemination strategies. A visual content analysis was conducted on QR code-embedded outreach graphics ($N = 105$) curated from official internet platforms of the [State] co-operative extension service. The graphics were assessed by qualified raters using a codebook based on graphic design principles including color, typography, layout, and visual hierarchy, as well as visual rhetoric attributes. The results revealed strong adherence to fundamental graphic design elements like symmetry ($n = 93$), balance ($n = 92$), visual clarity ($n = 85$) and contrast ($n = 97$). However, QR code placement was often supplementary, with only 53% of the sample placing primary emphasis on them. The findings also identified three dominant types of outreach materials—Registration/Survey/Poll (53%), educational/Informational (35%), and Promotional/Event (12%)—and showed 4-H participants as the most frequently targeted audience ($n = 70\%$). While most graphics adhered to professional design standards, only 38% utilized emotional imagery and 56% employed interactive elements indicating potential areas to enhance audience engagement. The study's findings suggest that QR codes should be purposefully placed in extension visual communication designs. To ensure that QR codes are both functional and aesthetically optimized, it is recommended that the extension service engages specific strategies in settings where access to digital content is essential.

Keywords

Extension outreach, QR Codes, Graphics, Visual communication, Graphic design

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Introduction

Today's consumers are more reliant on graphic visual communication for information consumption than on verbal or other traditional forms of information (Kujur & Singh, 2020). This significant shift, in most cases, stems from current audiences being attracted to graphics as a means of portraying and providing messages or information. Undoubtedly technology has significantly facilitated this production and circulation of images (Ledin & Machin, 2018). The integration of Quick Response (QR) codes in digital graphic design is seen as a potential way to improve information distribution and engagement by leveraging consumers' attraction to visuals (Vorobchuk & Pashkevych, 2023). Fortin and Surovaya (2018) posited that QR codes have become prominent interactive tools for transforming traditional publicity into more engaging and responsive communication platforms. These codes are being used widely for mobile payment, marketing, public transportation, and other applications, making them an integral part of modern communication with present and potential audiences (Pavlović et al., 2020).

In recent years, the integration of QR codes has provided a novel means of connecting extension audiences to additional content such as websites, videos, or digital resources (Hill et al., 2013). QR codes generate links to online content when scanned by a camera-equipped smartphone with a QR reader (Atkinson, 2013). Functioning like a two-dimensional barcode, QR codes provide a unique way to bridge the gap between producers and consumers, providing access to valuable information, resources, and services (Tagarakis et al., 2021). Because of QR codes' potential to improve digital communication, interest in exploring innovative delivery mechanisms to meet emerging trends and address specific needs of diverse audiences has increased in academia (Raison, 2014). Amidst the COVID-19 pandemic, virtual QR codes became a spontaneous, cost-effective, and quickly implementable method to access information on various platforms (Liang, 2020). Kartee et al. (2022) noted that over time QR codes gained popularity because of their adaptability and capacity to direct users to a significant quantity of information.

Davies et al. (2023) emphasized QR code versatility and significance in tackling present-day challenges in communication and information delivery. Such challenges include the need for contactless interactions to ensure public health and safety as exemplified by the COVID-19 crisis (Lee & Lee, 2021). There is a growing demand for instant, on-the-go access to detailed and up-to-date information across industries, from healthcare to education, and a recent shift in academia toward hybrid and online learning environments has created a need for innovative methods to deliver interactive and supplementary content effectively. Additionally, sustainability goals emphasize reducing paper usage and adopting environmentally friendly practices, including the use of digital communications over print publications. Also, QR codes are being employed in information security techniques such as optical encryption, watermarking, and steganography, highlighting their importance in ensuring secure retrieval of information and safeguarding data (Al-Saadi et al., 2021).

The Cooperative Extension System (CES), originating as a collaborative effort between universities, government bodies, and communities, has played a key role in enhancing knowledge dissemination and fostering growth in diverse sectors, such as agriculture, health, and community development (National Institute of Food and Agriculture, n.d.). Extension services worldwide have historically aimed to enhance agricultural productivity and clients' incomes through non-formal education, technology transfer, and knowledge dissemination, encompassing diverse areas such as crop and livestock management, natural resource conservation, rural development, nutrition education, and climate-smart agricultural practices (Ogundari, 2022).

This unique system, established over a century ago, translates scientific findings into actionable knowledge for farmers, ranchers, homeowners, youth, and families, addressing a wide range of public needs. Extension represents a bridge between academic knowledge and practical application, aiming to empower individuals and communities, through educational outreach and resource-sharing. Extension outreach programs increasingly depend on new technologies to publicize information and engage stakeholders due to reduced manpower and travel expenditures (Malone et al., 2022).

These approaches include exploring the use of mobile applications and social media platforms to reach a wider audience. Extension outreach graphics are visual materials that simplify complex information to effectively engage and inform diverse audiences in agriculture and community development, making complex topics accessible and actionable. QR code-embedded outreach materials have emerged as potential tools for enhancing extension (Campbell et al., 2022). Most materials are given to clientele through in-person interactions, field programs, and digital means (Aker et al., 2016; Bahn et al., 2021). The lack of access to digitized outreach resources is often due to insufficient digital literacy and lack of affordable technology among agents and clientele (Adeyemon, 2009). For example, in Arkansas specifically, 60% of rural residents now have access to internet that meets benchmark download/upload speeds, and, as a result, opportunities for remote work and access to essential services in rural areas are increasing (Slone, 2023). While many extension clientele in developing regions face barriers due to limited infrastructure and resources, recent initiatives aim to bridge this gap (Atheequalla, 2024). For instance, extension programs have been working to address digital inequities in rural areas by providing targeted support and resources (Campbell, 2022). There are also promising opportunities for leveraging these tools to enhance connectivity and access to information to communities.

One of the main directions for extension education research includes identifying innovative approaches to enhance the effectiveness of extension programs in delivering information and services to target audiences (USDA Science and Research Strategy, 2023). Extension digital technology research has addressed the use of QR codes in outreach graphics (Hill et al., 2013), the integration of digital tools in marketing extension events (Mahadewi, 2020), and the impact of technology on audience engagement strategies (Johnson & Lee, 2021). However, research on graphic design in extension has focused on the effectiveness of visual elements in communication materials, yet there remains a significant gap in understanding how graphic design influences QR code-embedded digital graphics for diverse audiences. There is a need for specialized content strategies tailored to the unique requirements of different audiences (Zurbi, 2023). As digital technologies continue to evolve, exploring these visual aspects could enhance outreach and engagement efforts in extension work.

Theoretical and Conceptual Framework

This study was grounded in the visual rhetoric theory (Durand, 1987) and the visual hierarchy model (Faraday, 2000), which provided a lens to assess the integration of QR codes in extension outreach graphics. By considering both the persuasive function of visuals and the cognitive processes of the viewer, this framework guided an evaluation of how QR codes and other visual design elements work together to enhance communication, engagement, and outreach goals. Visual rhetoric theory suggests visual elements serve as symbolic artifacts conveying messages and influencing audiences beyond traditional textual strategies (Bakri et al., 2022; Durand, 1987). Visual rhetoric emphasizes the persuasive role of visual communication,

where ethos (credibility), pathos (emotions), and logos (logic) are employed to appeal to audiences (Bakri et al., 2022; Meehan et al., 2011).

Specht and Rutherford (2013) utilized the visual rhetoric framework to examine the emotional and cognitive impact of media portrayals of agriculture. Their findings demonstrated that emotionally resonant imagery could shift public perceptions, underscoring the influential role of visuals in shaping agricultural narratives. Similarly, Fortin and Surovaya (2018) showcased how QR codes, when used as interactive visual tools, can transform passive campaigns into active engagement platforms. Their study supports the use of visual rhetoric to heighten audience response through design integration. In the context of extension outreach graphics, visual rhetorics are observed through the strategic integration of visuals, verbal content, and official logos enhancing the effectiveness of communication by engaging the audience both emotionally and intellectually (Wang et al., 2023). QR codes, as visual elements, align with this framework by encouraging audiences to engage further by means of scanning to get unlimited access to more extension content beyond the static graphic.

The visual hierarchy model complements visual rhetoric by providing a structured approach to the design and arrangement of visual elements within each outreach graphic. This model posits the human brain organizes individual elements into cohesive wholes, enabling more efficient navigation and interpretation of information. It guides the viewer's attention through designed graphics by prioritizing key elements—such as the QR code—through variations in size, focus, and layout (Asif & Burton, 2021; Scalzo & Piater, 2005). Asif and Burton (2021) pointed out how visual prominence achieved through deliberate decisions regarding size, positioning, and contrast can direct viewer focus and improve interpretive clarity. This aligns with the model's premise that effective visual ordering facilitates cognitive processing and retention. The design and placement of design elements enables the cognitive processes of searching and scanning, as outlined by Faraday (2000), ensuring viewers locate essential information quickly and engage with the graphic as intended.

QR codes are not merely functional elements but also persuasive digital tools. Their inclusion signals to the audience that more information is accessible, appealing to both logos (logic) by providing additional resources and ethos (credibility) by positioning the communication as informative and trustworthy (Meehan et al., 2011). When a QR code is visually prominent and well-integrated within the design, it is more likely to capture attention during the viewer's initial search and scanning processes (Holten & van Wijk, 2008), effectively guiding the viewer's eye to the most critical information first, helping them understand the purpose of the graphic and any required actions.

Effective QR code integration requires attention to design elements, including size, placement, and visual hierarchy. As noted by Ledin and Machin (2018), QR codes should be strategically positioned in visually prominent areas to maximize interaction. However, some findings caution QR codes can clutter designs if not thoughtfully integrated, potentially detracting from the overall visual appeal of educational materials (Asif & Burton, 2021). Kuribayashi and Morii (2017) suggested the aesthetic customization of embedding QR codes as a solution to enhance integration, making the codes visually cohesive with educational graphics without compromising functionality.

Purpose and Research Objectives

Well-designed outreach materials can enhance attention and focus on information, making them particularly valuable in the context of extension education and outreach (Worley et al., 2024). Digital graphics attract attention and spark interest, ultimately serving as catalysts for

knowledge acquisition. The purpose of this study was to assess how extension has used visual communication design strategies through the integration of QR codes in outreach materials. This purpose was achieved through the following objectives:

1. Assess and quantify visual design elements used in QR code-embedded extension graphics.
2. Assess and quantify visual rhetoric attributes used in QR code-embedded extension graphics.
3. Determine the types of graphics and intended audiences associated with QR code-enabled extension outreach.

Methods

Design of the Study

This study employed a visual content analysis based on assessing outreach media using a pre-established code book developed from graphic design elements and visual rhetoric concepts. This approach focused on graphic design principles, visual hierarchy and visual rhetoric theory constructs used in placing QR codes in outreach graphics supporting extension programs in Ozark district. This approach also aided in delineating communication material, specifically focusing on media imagery and attributes (Kassarjan, 1977). The code book was adapted from established defined primary categories such as image clarity, hierarchy, contrast, persuasive intent to capture specific design and rhetorical features. By quantifying the presence of visual and persuasive elements, the approach provided an ample understanding of how design choices in extension outreach materials influenced communication outcomes and user engagement.

The research approach was structured around two aspects. First, a multiple coder analysis was conducted using the code book to ensure reliability and consistency in identifying the use of visual design principles across outreach materials. This coding process allowed for cross-validation of findings. Second, a single coder analysis was performed to identify broader visual themes, types of graphics and intended audiences represented in the dataset. Creswell's (2013) qualitative research guidelines support single-coder analysis when categories (graphic types and audiences) are defined. By integrating both the assessment of visual and rhetorical elements and the exploration of themes and targeted audience, the study approach offered a thorough understanding of QR-embedded outreach media utilized in the Ozark district.

Content Selection

The outreach communication graphics containing QR codes were selected and downloaded over a two-week period in 2024. Outreach posts included print and electronic graphics accessed via the official digital platforms of the 25 counties in the Ozark district. The selected graphics consisted of digital brochures, flyers, social media posts, presentations, and banners from the official county websites and social media accounts for the program areas of 4-H youth development, family and consumer sciences, civic education, and agriculture. These materials were published over a two and a half year period, from the onset of the COVID-19 pandemic, January 2020 through June 2022. The decision to curate materials through 2022 was guided by relevance, completeness, and methodological consistency. The year 2022 was selected as a cutoff to ensure the dataset was both comprehensive and analyzable, as content from more recent years such as 2023 and 2024 may not have been fully published, circulated, archived, or widely disseminated in different media at the time coding began.

Though originally 113 outreach graphics were curated, only 105 were used in the final coding process under inclusion criteria set to guarantee analytical consistency and relevance. Graphics that were duplicates, lacked basic visual components or were out of scope for the goals of the research were deleted. Furthermore, certain visuals that might have shown technical problems like poor quality that prevented dependable coding (Golombisky & Hagen, 2010) were omitted. By means of this filtering, the dataset utilized for analysis was both practically sound and representative of the kinds of images pertinent to the study topics.

Instruments

Codebook

Each of the selected outreach graphics was evaluated using a researcher developed code book. Images and design components of graphics were organized under separate categories to be evaluated. The coding process was guided by established principles of visual communication and rhetoric but limited to color, typography, composition and visual hierarchy for this study (Josephson et al., 2020). Graphic design standards and constructs from the visual rhetoric theory formed the criteria for assessing designed extension graphics. Standard concepts of design and placement such as symmetry, balance, proportion, contrast, proximity, and unity were used to assess the outreach graphics. The code book used a dichotomous scale to allow raters to quantitatively assess the outreach graphic's quality using Qualtrics. Figure 1 shows the design criteria and descriptions used in the codebook by the raters.

Figure 1

Codebook used for visual content and audience analysis

Design Criteria	Detail	Description / Example
Visual Hierarchy (Ugur, 2019)	Symmetry	Elements are evenly mirrored on creating harmony
	Balance	Visual weight is evenly distributed across the graphic design
	Alignment	Elements are arranged along a common edge, making the outlook orderly.
	Proximity	Group-related elements are close together, showing their connection.
	Contrast	Noticeable differences between elements, making them stand out
	Unity	Elements appear together as a cohesive whole.
Design Elements (Chen et al., 2003)	Consistent Font Type	Relatable font is used throughout the design to maintain uniformity.
	Consistent Font Size	Consistent across similar text elements for a cohesive look
	Consistent Color	The same color for similar types of text is used to ensure visual harmony.
	Consistent Font Legibility	The text is easy to read with clear spacing contrast against background.
	Relatable Secondary colors	Colors complement the primary colors for the design's theme.
	Color Harmony	Colors used gel well together, creating a pleasing and balanced look
	Acceptable Image quality	Images are clear, sharp, and not pixelated or blurry.
	Relevance to Content	The image directly supports and reinforces the message content. Design is attractive and engaging, drawing in the viewer's attention.
	Visual Appeal	
	Consistent Image Style	Images create a cohesive style and design.
	Prominent placement	Key images are placed where they are easily noticeable.

	Favorable Size	Elements are sized appropriately with key elements to draw attention.
Visual Rhetoric (Zahra, 2021)	Emotional Imagery	Images evoke emotions to connect with the audience
	Persuasive Text	Text is compelling and designed to the viewer
	Official Logos or Seals	Official logos or seals are used to establish credibility and trust.
	Professional Appearance	Overall design looks clean, and suitable for the intended audience.
	Actionable Language	The text includes clear calls to action, prompting the audience.
	Clear Instructions to Scan	The design includes straightforward directions to scan a QR code.
	Audience engagement	Additional features in QR code that encourage the viewer to interact
	Questions and prompts	Use of prompts that encourage the viewer to think, respond, or act.
Placement of QR code (Identified inductively)	Clarity of QR code	Clear direction of the visual path in the graphic to the QR code.
	Primary Focus on Code	Some emphasis is drawn to the QR Code.
Type of Audience (Seevers et al., 1997)	Farmers and Ranchers	Individuals or businesses which are involved in crop or livestock production.
	Youth & 4-H Participants	Youth that engage in projects ranging from crop / animal care to robotics.
	Entrepreneurs	Individuals starting or managing businesses, often related to extension
	Community leaders	Individuals involved in making decisions for community development
	Families & Home gardeners	Homeowners that seek extension services for practical knowledge
	Natural Resource Clients	Individuals or organizations focused on managing natural resources

Note: Criteria listed in the table were used for coding by raters in Qualtrics®

Coding Procedures

Team Coding for Objectives 1 and 2

Five agricultural education, communication, and leadership graduate students with practical knowledge and experience in graphic design were employed as coders. To achieve research objective one the researcher created a training handbook based on graphic design and cooperative extension literature to ensure each person was familiar with the criteria and descriptions (McPhail et al., 2019). After this phase, coders familiarized themselves with the codebook and assessment criteria, using three outreach graphics not included in the total pool for final analysis, to address any discrepancies or uncertainties with coding. This collaborative effort led to codebook refinement, improved clarity, and reduced ambiguity. The coders were provided with clear and detailed guidelines, which outlined the specific criteria for evaluation and offered examples to assess different design attributes and characteristics (Lavee, 2021). Using a questionnaire form, each coder was presented with a set of QR-embedded graphics via a Qualtrics® link to code for presence (1) or absence (0) of visual hierarchy and rhetoric design elements.

With this guide, the coders were able to align their evaluations more closely (Neuendorf, 2002), leading to an acceptable level of inter-rater reliability. The coded data from all raters was collected and organized, and Fleiss' Kappa was chosen as the statistical measure due to its ability to handle multiple raters and categorical data (Fleiss, 1971). Consistency in data interpretation using analysis is vital for supporting the overall dependability of the research, and inter-rater

reliability (Smith & McGannon, 2017). The purpose of ensuring the consistency in interpretation was twofold: to enhance uniformity in coding across different raters and to facilitate the future replication of the study by other researchers. This ensured that the set of coders working with the set of codes may use the same materials to get the same results (O'Connor & Joffe 2020).

To calculate Fleiss' Kappa, the proportion of ratings were computed in each category and the observed agreement for each item was calculated for the average observed agreement. Thereafter, the researcher verified the coders' agreement, comparing their assessments. Finally, the formula to compute Fleiss' Kappa, which measures inter-rater agreement, with values ranging from -1 (poor agreement) to 1 (perfect agreement) was applied. The k value calculated for the initial coding activities was 0.76, which indicated a substantial coder agreement (Stemler, 2019). Once the standard level of inter-rater reliability was established, the full set of outreach materials was then randomly assigned among the coders for final coding.

Single-coder Inductive Visual Coding for Objective 3

Additionally, to achieve research objective 3, visuals related to the content and messages included in outreach graphics were identified by a single coder (Neuendorf, 2017). They included the type of information used, target audience, and call-to-action cues. Braun & Clarke (2006) argue that thematic analysis is a flexible method and can be effectively conducted by a single researcher when they engage in a reflexive, transparent process. The researcher assessed and examined the outreach graphics and coded the graphics according to the predetermined categories based on literature, ensuring a complete valuation of the graphic elements and audience attributes. A denotative analysis approach was taken to examine the outreach materials, therein focusing on an objective assessment of the graphics. The associative value of the designed graphics was then determined by analyzing the elements in it for inference (Edgar & Rutherford, 2012).

Data Analysis

Visual Content Analysis

The visual rhetoric theory, as applied in graphic design, plays a significant role in attracting and engaging viewers (Senoyamak, 2017). The deductive coding of visual design elements focused on identifying and categorizing presence or absence of the use of appropriate color, imagery, QR code placement, and layout in outreach graphics curated, incorporating constructs from visual rhetoric theory and the persuasive potential of visuals aids in graphic design (Holten & van Wijk, 2008). Each of the five coders coded for presence or absence of the visual elements in twenty-one assigned graphics totaling one hundred five outreach graphics in all. Color usage was examined in terms of its emotional and symbolic associations, as well as its ability to create visual hierarchy and contrast. Imagery analysis included the evaluation of the types of visuals used (photographs, illustrations, icons) and their relevance to the extension context. The categorization of these elements is consistent with the methodological framework proposed by Ledin and Machin (2018) for conducting visual analysis.

The frequency of presence and absence of the standard graphic design attributes, and types of outreach graphics were computed. The total scores for each promotional item were then determined using Microsoft Excel® 2023 computer software. Descriptive statistics were utilized by recording the frequency and percentages of presence or absence of visual design elements usage in the total number of outreach graphics. Layout analysis considered the overall organization of visual elements and the use of white space to guide viewer attention. The use of

visual analysis facilitated the identification of and occurrences of visual elements in the outreach graphics using Lincoln and Guba's (1985) constant comparative technique.

Categorizing and Evaluating Overall Design Elements and Target Audience

To achieve objective one and two, analysis of the outreach graphics involved grouping and examination of the design elements and attributes. Each outreach graphic was coded for the different design features including the visual elements, typography and layout. The attributes were then assigned specific codes by coders to facilitate their assessment, and the resulting data were organized into a structured format in Microsoft Excel, which facilitated counting the frequency of occurrence of each design element for each graphic across the entire sample. This process allowed for the identification of occurrence distributions, prevalence of specific design features, and patterns across different elements. Thereafter, the results of these procedures allowed for the interpretation of visual aesthetics, messaging effectiveness, and overall design coherence with the integration of QR codes.

Data analysis to achieve objective three involved the researcher identifying each intended audience type by language usage, picture or icon choice, and subject relevance on a separate basis for each graphic (Mogull, 2024). A notable aspect of this process was the recognition that a single graphic could target multiple audiences simultaneously. This approach allowed for a detailed understanding of how extension materials were crafted to communicate with various groups. Each graphic was analyzed and assessed, with a detailed examination of language, images, and topic matter to determine a precise audience and graphic type profiles. Although audience identification based on content analysis inherently carries limitations—particularly regarding assumptions about audience intent—this approach remains a widely accepted method in visual communication research (Messaris, 2019). Interpreting intended audiences from visual and textual cues does introduce subjectivity; however, operational definitions and clear coding protocols were employed to mitigate these risks and maintain analytical consistency. This process allowed for a thorough assessment of each graphic's design elements and content, ensuring a comprehensive understanding of the purpose and how each outreach graphic was tailored to its intended audience.

To assess whether the observed difference in distributions of graphic types and visual themes significantly deviated from an expected uniform distribution in a population, a Chi-square (χ^2) test for goodness-of-fit was conducted. The test evaluated whether the frequencies of occurrences across different categories were significantly different from what would be expected under equal distribution in a given population. Ultimately, two Chi-square values were calculated to determine significant differences among visual themes of graphics (5) and among types of graphics (3). Statistical significance was established *a priori* at $p \leq .05$.

Results

The researchers, in pursuing the study's first objective evaluated the visual design elements and attributes of visual rhetoric in extension outreach graphics containing QR codes. Table 1 shows the number of graphics with observed use of basic design, layout and composition elements with their respective percentages. The assessment revealed a majority of the outreach graphics adhered to essential design principles such as symmetry ($n = 89$, 93%), balance ($n = 92$, 88%), visual clarity ($n = 85$, 81%), and alignment ($n = 92$, 88%), ensuring a visually cohesive structure. Design attributes such as proximity ($n = 97$, 93%) and contrast ($n = 97$, 93%) were also prominent, contributing to a clear separation of content and enhancing readability. Similarly, unity ($n = 93$, 89%) scored higher, indicating individual elements were well-designed and

cohesive in the outreach graphics. The prominent placement drawing focus on QR codes was noted in only 56 (53%) graphics.

Table 1

Overall Design Layout and Composition of Outreach Graphics (N=105)

<i>Layout / Composition</i>	<i>n</i>	<i>%</i>
Symmetry	93	89%
Balance	92	88%
Alignment	92	88%
Proximity	97	92%
Contrast	97	92%
Unity	93	89%
Primary Focus on QR Codes	56	53%
Visual Clarity	85	81%

Consistent font type ($n = 79$, 75%), consistent font size ($n = 76$, 72%), and consistent font color ($n = 81$, 77%) were employed in the sample. Additionally, the legibility of the fonts ($n = 79$, 75%) was moderately rated. Table 2 gives an outlook of the legibility of related typography design attributes used in extension outreach graphics.

Table 2

Clarity and Legibility of Typography in Graphics (N=105)

<i>Typography</i>	<i>n</i>	<i>%</i>
Consistent Font Type	79	75%
Consistent Font Size	76	72%
Consistent Font Color	81	77%
Consistent Legibility of Font Used	79	75%

One of the key focuses of this study was the integration of QR codes in extension outreach communication graphics. Table 3 shows the observed presence of visual image quality attributes in the embedded graphics. While clarity ($n = 96$, 91%) of QR codes was a strength, only 70% ($n = 74$) of the graphics placed primary emphasis on sizable QR codes as a central visual element.

Table 3

Observed Image Quality and QR Code Integration (N=105)

<i>Imagery</i>	<i>n</i>	<i>%</i>
Acceptable Image Quality	83	79%
Relevance to Content	96	91%
Visual Appeal	71	68%
Consistency in Image Style	94	90%
Prominent Placement on the Page	76	72%
Favorable Size	74	70%
Clarity of QR-Code	96	91%

Prominent placement of the QR codes was identified and rated for the outreach graphics ($n = 76$, 72%), indicating the codes were visible but not always central to the communication strategy. After coding, image quality was deemed acceptable in 83 (79%) graphics, while visual appeal was rated moderately relative to 68% ($n = 71$) of the outreach materials. However, the consistency of image style was only observed in 90% ($n = 94$) of the designs. In terms of color usage, primary colors ($n = 79$, 75%) and secondary colors ($n = 76$, 72%) were commonly present. The overall aesthetic appeal was heightened through the coherent application of color harmony ($n = 86$, 82%), where different hues worked together to create a balanced and visually attractive layout. Table 4 illustrates the use of visual rhetoric attributes in extension outreach graphics.

Table 4*Observed Use of Visual Rhetoric in Extension Graphics (N=105)*

<i>Appeal to Emotions</i>	<i>n</i>	<i>%</i>
Use of Emotional Imagery	40	38%
Use of Persuasive Text	68	65%
Use of Official Logos or Seals	85	81%
Professional Appearance	85	81%

The researchers assessed and quantified the visual rhetoric attributes present in QR code-embedded extension graphics to achieve the second objective. The findings were sorted into the observed use of visual rhetoric and audience engagement, providing insights into the strengths and areas for improvement in the use of QR codes as a communication tool in extension. Forty-eight percent of the QR graphics ($n = 42$) employed emotional text to connect with their audience. The analysis of the outreach graphics revealed a moderate incorporation of official logos and seals, with ($n = 85$, 81%) of the graphics including such elements. Furthermore, the use of emotional imagery was present in 38% ($n = 40$) of the sampled graphics.

Engagement features with the target audience were analyzed to determine how well the graphics prompted user interaction. Only 56% ($n = 59$) of the designs featured interactive elements such as clickable links or interactive prompts. Additionally, only 46% ($n = 48$) included questions or prompts designed to engage the viewer. While all outreach graphics contained QR codes, only 40% ($n = 42$) of the graphics had clear instructions to scan the QR code. Table 5 illustrates the audience engagement features observed in the graphics.

Table 5*Audience Engagement Features in Graphics (N=105)*

<i>Audience Engagement</i>	<i>n</i>	<i>%</i>
Presence of Actionable Language	67	64%
Clear Instructions to Scan	42	40%
Options for Audience Engagement	61	58%
Interactive Elements	59	56%
Use of Questions or Prompts	48	46%

The third research objective in this study was to determine the types of graphics, and intended audiences associated with QR code-enabled extension outreach. In addressing this objective, the graphics analyzed were inductively categorized into three primary types: Registration/Survey/Poll, Promotional/Event, and Educational/Informational. Five visual themes emerged after observation of each outreach graphic: Civic participation and advocacy, Economic development and Workforce training, Agricultural outreach, Youth and education programs, and Health and wellness.

Table 6 shows the number and percentages of observed types and visual themes of the QR code-embedded graphics. The most prevalent type of graphic published was Registration/Survey/Poll, accounting for 53% ($n = 56$) of the graphics sampled. These graphics typically included QR codes to facilitate participant registration, feedback collection, or polling. The educational/informational graphics constituted 35% ($n = 36$). These materials were focused on disseminating knowledge or providing instructional content, often linking QR codes to more detailed online informational and educational resources. Lastly, promotional and event banners made up only 12% ($n = 13$) of the sample primarily used to advertise upcoming extension events or initiatives, where QR codes offered a way to access event details or registration pages. The distribution of these graphic types was statistically significant, ($\chi^2 (df = 2) = 26.43, p < 0.05$), indicating a significant variance in the types of extension outreach graphics used to integrate QR codes. Further analysis categorized the graphics by visual thematic focus. Youth and educational programs emerged as the most common, representing 31% ($n = 33$) of the graphics. These were followed by economic development and workforce training graphics, accounting for 26% ($n = 27$). Agricultural outreach materials made up 21% ($n = 22$) while civic participation and advocacy as well as health and wellness were represented by 10% ($n = 10$) and 12% ($n = 13$) of the sample, respectively.

Table 6
QR Graphic Types and Visual Themes of Study Sample

	<i>n</i>	<i>%</i>
<i>Type of Graphic</i>		
Registration / Survey / Poll	56	53%
Promotional / Event	13	12%
Educational / Informational	36	35%
<i>The Visual Theme of Graphic</i>		
Civic Participation and Advocacy	10	10%
Economic Development and Workforce Training	27	26%
Agricultural Outreach	22	21%
Youth and Education Programs	33	31%
Health and Wellness	13	12%

To determine whether the distribution of different categories of graphics within the dataset deviated significantly from an expected uniform distribution in a given population, a chi-square (χ^2) goodness of fit test was conducted for both the type of graphic published and the visual theme of the QR embedded outreach graphic. Using the chi-square formula $\chi^2 = \sum [(O - E)^2 / E]$ where O represents the observed frequencies and E the expected frequencies, the computed test statistic was $\chi^2 (2) = 26.43$, with an exact p -value of 1.80×10^{-6} . Given that the p -value was far below 0.001, the results indicate a highly statistically significant difference in the frequency of different types of published graphics, suggesting that certain types were used much

more frequently than others. The chi-square test resulted in $\chi^2(4) = 17.42$, with an exact p -value of 0.0016. These results suggest that the difference in number of published graphic types was significantly different whereas the visual themes were less pronounced differences.

Among the 105 graphics analyzed, the media targeting youth and 4-H participants were particularly noteworthy, with the number of audiences related to QR graphics, constituting 67% ($n = 70$) of the total graphics. Farmers and ranchers emerged as another targeted audience, identified in ($n = 53$, 50%) graphics in the sample. Families, home makers, and gardeners were a moderately identified group, which constituted 41% ($n = 43$) of the sample. Graphics targeted for entrepreneurs and workforce training audiences were identified, with 45% ($n = 47$) graphics dedicated to this group. Similarly, community leaders ($n = 35$, 34%), natural resources ($n = 43$, 41%), and environmental clients had less outreach graphics targeting them.

Table 7 illustrates the different audience targeted and their estimated percentage of the total outreach graphics.

Table 7

QR Graphic per Type of Related Audience (most frequent audience only)

<i>Type of Audience targeted</i>	<i>n</i>	<i>%</i>
Farmers and Ranchers	53	50%
Youth and 4-H Participants	70	67%
Entrepreneurs and Workforce training	47	45%
Families, Homemakers & Gardeners	43	41%
Community Leaders	35	34%
Natural Resources and Environmental Clients	43	41%

Note: Types of audience were identified deductively using guidelines from Seevers et al. (1997). Most QR graphics targeted multiple audiences, this is why the total percentage exceeds 100%

Discussion

Objective one was accomplished by evaluating and quantifying the visual design elements embedded in extension graphics with QR codes, revealing considerable adherence to fundamental design principles. This included effective use of color and typography, which enhanced readability and aesthetic appeal, aligning with Bakri et al. (2022) on the persuasive power of visuals in guiding attention and supporting message clarity. The strategic use of color ensured the readability and visual appeal of QR codes, underscoring their role as dynamic visual tools in capturing attention (Meehan et al., 2011). Effective color contrasts were applied to integrated QR codes within graphics without overpowering other visual elements, promoting scannability and coherence with the overall design (Faraday, 2000). However, emotionally engaging elements, such as compelling imagery and evocative text, were underutilized, a gap that could limit emotional connection and message retention. As indicated by visual rhetoric theory (Durand, 1987; Kenney, 2002), employing pathos—appealing to audience emotions—can enhance behavioral motivation and engagement, an aspect less expressed in these graphics. Addressing this gap could enhance the persuasive appeal and long-term impact of these outreach materials.

Also related to objective one, the findings showed QR codes were positioned as secondary elements, slightly aligning with the visual hierarchy model, which emphasizes the need to guide viewer attention to critical information first (Scalzo & Piater, 2005). This also supports visual hierarchy theory, which posits viewers' attention flows logically to key

components (such as the QR code) through variations in size and layout. The cognitive structuring in the graphic allows for efficient navigation, as viewers can identify and engage with essential content promptly (Fu et al., 2008). Consequently, the design strategies adopted in these graphics supported the communication goals, though there remains room to enhance the emotional appeal and interactivity to maximize audience engagement. Interactive design improvements could amplify impact where the effective integration of digital tools could help elevate engagement. Training programs focused on expanding the use of interactive and emotional design could help address these needs, promoting a more comprehensive approach to QR code integration.

Objective two was addressed by analyzing visual rhetoric attributes embedded within the QR code-enhanced graphics, which highlighted the codes' role as persuasive and symbolic tools within the context of extension outreach. QR codes served as functional yet underutilized engagement tools, echoing Handley (2012), who noted, while QR codes are widely used, their full potential for audience engagement often remains untapped. In many instances, graphics relied heavily on credibility markers, such as logos and official symbols, to convey trust and authority (Wang et al., 2023). This aligns with the concept of ethos within visual rhetoric theory, where elements symbolizing credibility play a role in establishing trust with the audience. However, a stronger emphasis on visual storytelling could further enhance the graphics' persuasive impact by deepening emotional engagement, thereby improving information retention and fostering motivation for behavioral change (Rotsios et al., 2022).

While logos and credibility-enhancing elements were prevalent, a marked underuse of pathos-oriented design was noted by the absence of vibrant imagery and emotive text. Integrating such elements could strengthen emotional appeal, offering a balanced rhetorical approach encompassing ethos, pathos, and logos to appeal intellectually and emotionally (Bakri et al., 2022). The findings suggest a well-integrated QR code within a visually appealing design can reinforce trust and encourage interaction by positioning the communication as both informative and credible. A systematic approach to evaluating and implementing visual rhetoric can help improve the efficacy of outreach graphics, suggesting future design efforts should focus on establishing an emotional connection with audiences to increase engagement.

Objective three involved identifying graphic types, and target audiences within QR code-enabled extension outreach. Among the graphics identified, youth and education programs emerged as dominant, accounting for nearly one-third of the sample. This focus aligns with extension's mission of youth development and 4-H programming. Economic development and workforce training and agricultural outreach were also prominent, reflecting the ongoing importance of these outreach types supporting rural communities and agriculture-based economies. Civic participation and advocacy, along with health and wellness, constituted smaller proportions. However, no significant differences were observed in the distribution of these thematic focuses, suggesting an overall balanced thematic approach across outreach materials. The study revealed registration, survey and poll graphics were the most utilized type of QR code-enabled outreach materials, comprising over half of the sample.

The registration, survey and poll graphics primarily served functional purposes, such as facilitating participant engagement through registration, feedback collection, or polling. Meanwhile, promotional and event graphics were used more sparingly. The significant variance in the distribution of these graphic types underscored a strategic prioritization of functional and educational applications of QR codes within extension communications. Analysis of intended audiences further emphasized the prominence of youth and 4-H participants as a key target group. This trend highlights the alignment between QR code-enabled graphics and the strategic

objectives of extension programming to foster youth engagement and participation. The predominance of functional and educational graphic types, coupled with a thematic focus on youth and economic development, illustrates how the QR codes have been used to enhance accessibility and audience engagement. However, the underrepresentation of promotional/event graphics and outreach graphics, like civic participation and health, suggests opportunities for expanding the scope and diversity of QR code applications in extension outreach communications.

The analysis showed a broad use of QR codes across various sectors, including youth programs, agriculture, health, and community leadership, underscoring the versatility of QR codes as tools for engaging diverse audience groups. However, health and civic engagement topics had less representation even though the QR codes were increasingly used in different sectors to communicate these topics during and after the pandemic for the graphics assessed. This aligns with findings from Zurbi (2023), which support the need for specialized content strategies tailored to the unique circumstances of different audience groups. QR code integration in health and wellness could drive higher engagement levels in these areas, especially if coupled with design strategies that highlight the relevance and accessibility of information. The variation in QR code usage across the different audiences demonstrates both the adaptability and the potential of QR codes to address specific information needs, emphasizing the importance of targeted content strategies (Tagarakis et al., 2021).

Outreach graphics predominantly targeted youth and 4-H members, suggesting these age groups are the primary focus of post-covid extension initiatives. However, broadening the audience scope to include other audiences could enhance community-wide engagement. This may well point to a gap in outreach planning where groups that play critical roles in environmental stewardship and community decision-making for example could impact the effectiveness of broader outreach goals, such as fostering community support, promoting natural resource management, or encouraging environmental initiatives.

A limitation of this study existed in relation to Objective 3, where the intended audience for each outreach graphic was based solely on the researcher's understanding of Extension audiences from literature, the visual content and graphic design. While these graphics may visually suggest target demographics through design and messaging, this approach did not account for the complexity of actual user engagement with QR codes. User behavior around QR code scanning is unpredictable and could be influenced by factors beyond design intent. The likelihood of gaining attention to scan depends on clear incentives, and cultural familiarity. The actual users who might scan QR codes may differ from the intended targets due to different factors. Additionally, the findings of this research are specific to the Arkansas CES.

Recommendations for Practice and Future Research

To enhance the effectiveness of QR code-enabled extension outreach graphics, extension outreach practitioners should focus on improving visual appeal and emotional engagement by incorporating compelling imagery and evocative text. Balancing visual rhetoric elements—ethos (credibility markers), pathos (emotional appeal), and logos (logical structure)—can foster both intellectual and emotional connections with diverse audiences. Outreach communicators should also prioritize visual hierarchy by positioning QR codes strategically to guide viewer attention effectively, using variations in size, color contrast, and layout to ensure scannability while maintaining design coherence. Training programs for extension professionals can support these efforts by providing skills to integrate QR codes prominently without overshadowing other graphic elements.

Future research should explore long-term engagement strategies for QR codes, focusing on sustaining interest with its novelty diminishing. This includes studying the effectiveness of integrating interactive features and emotional content to maintain audience attention. Evaluating the impact of visual rhetoric driven elements can provide insights into optimizing communication outcomes. Additionally, demographic-specific studies should identify the unique informational needs and design preferences of various audience groups, particularly adults and underserved populations. Lastly, the development of comprehensive evaluation frameworks is essential for assessing the emotional, cognitive, and behavioral outcomes of QR code-enabled graphics. These frameworks can also help measure the role of QR codes in addressing digital divides and expanding the reach of extension resources across rural and urban communities.

This study provides insights as one of the first evaluations of QR code integration in extension outreach graphics. The findings underscore a strong foundation in interactive design practices but also highlights where QR code focus, prominent placement and size could be enhanced. By adopting a more holistic approach to QR code design, extension professionals can better harness these tools to fulfill their outreach objectives, particularly by ensuring QR codes remain visually prominent and easily scannable within the context of the graphic (Campbell et al., 2022). Expanding the use of interactive elements could improve the overall effectiveness of extension outreach materials, particularly in meeting the diverse needs of rural and urban communities (Nickens et al., 2023). These findings can help support future training and development initiatives focused on enhancing QR code usability and aligning visual rhetorics with the communication goals of different audience segments for extension professionals.

Future research should delve into the impact of interactive features, emotional engagement, and demographic-specific approaches to extend the reach and effectiveness of QR code-enabled graphics. Ultimately, by refining QR code embedded outreach strategies and exploring audience-focused innovations, extension programs can advance their outreach impact and align with the evolving informational needs of diverse communities.

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