Visual Layout and Storytelling as Tools for Communicating Cognitive Bias to Undergraduate Students in Taraba State University

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ABSTRACT

Findings about the science of behaviour of people is hardly understood by non-specialist that is the people who have less or no experience in that part of science field just the same way undergraduate students only come across the concept of cognitive bias in an abstract sense that does not give deeper or clear understanding because it's a concept that only come across in textbooks or lecture slides. So this study sort to know whether the combination of structured learning layout together with narrative storytelling can improve the effect of understanding cognitive bias especially the confirmation of bias by undergraduate students in Taraba State University, Jalingo. The first page of a two page infographic presented the concept through organized text and visual hierarchy while the second page gave an illustration of the content in first page through a short story about an imaginary student, and this materials was shared to 30 undergraduate students from different facilities that include science, social science and humanities and the data was gathered through a structured questionnaire that has a combination of comprehension questions, a 4-point likert scale with 8 items and two open-ended questions. The findings showed a majority of undergraduate students with 73.3% gained full understanding of being able to confirm bias just after going through the materials one time and the total agreement of students throughout the 8 items reached 89.2%. Again the two items that addressed the effect of storytelling scored 93.3% and the answers gotten from the open-ended questions identified the narrative element as the feature that is most helpful with about half of the students describing how they personally got connected to the story with their own academic behaviour. This study concluded that instead of using one of the features, to combine layout and storytelling can lead to a better and stronger comprehension and personal relevance. So it recommended that science communicators and science educators who are preparing materials they can use to elaborate abstract concepts should be mindful to consider layout decisions like visual hierarchy, chunking and white space to be a basic part of material design and not just a finishing step of the content.

Keywords: cognitive bias; science communication; visual layout; storytelling; undergraduate engagement; behavioural science

INTRODUCTION

Science Communication could be understood as a two-way relationship that exist between researchers and the audience that their work is supposed to serve instead of just seeing the communication as a one-way transfer of facts from researchers to audiences. And this is a shift from the deficit model whose assumption was that the members of the public where just like empty vessels that just needed to be filled with information, to a new approach that starts with what the audience already know, value and find relevant(Trench and Bucchi, 2021). This point was also supported by Fischhoff and Scheufele (2019) who stated that communicating science well depends on how much and information is packaged and how accurate the same message is delivered. The two separate way of how information is packaged and how accurate it is delivered matters especially in the science of behaviour which is a field that has findings about decision-making, judgement and everyday choices but such rich information can only be found on the pages of academic papers and journals. In Nigeria, Adeyemi and Ogunyemi (2020) observed that science information including in behavioural research is most times presented in such a way that people who lack or have less knowledge about the field can connect and this is a problem that leaves a gap between what researchers know and what ordinary people including students actually understand.

This gap in science behaviour findings can be found in the concept of cognitive bias: a concept Korteling et al. (2021) described as predictable errors in reasoning that arise from the tendency of the brain to process information quickly instead of doing so cafefully and this is a tendency that is present in everyone regardless of person's intelligence or education. Confirmation bias is the tendency to quickly favour an information that aligns with what you already know or believe while neglecting the evidence because it contradicts it; this is one of the most common important bias of all biases for students since it influences how students evaluate sources, form their opinions and how they approach approach their academic work. Achinewhu-Nworgu et al. (2021) showed that students who are aware of their own biases have a stronger critical thinking and have more careful evaluation of evidence. But students still find it difficult to build such awareness when bias is taught only as an abstract definition. Just as Obi and Aliede (2021) showed that undergraduates in Nigeria most times struggle to understand abstract concepts in science when they are presented as much text and no visual work which is a pattern that only gives students a surface level understanding of a concept instead of working to have a better understanding.

In order to solve this problem, there are two strategies that have been proposed as effective remedies and this include structured visual layout which means the deliberate arrangement of text, images and white space of a page which has been shown to make comprehension easy by reducing the mental efforts students spend simply trying to locate and order information (Mijksenaar, 2019; Olaolu & Sanni, 2022); and narrative storytelling which works in a different way. Storytelling involves giving an abstract idea the shape of a human as this allows audience to encounter ideas that are not comfortable and not familiar including to discover that their own thinking is biased in a safe and relatable way (Appel & Mara, 2021; Joubert et al., 2019). Brossard and Scheufele (2023) showed that to combine visual clarity with narrative elements have shown its outperformance over using only one of the approaches. But even with these evidence people still treat the strategies as separate design choices instead of viewing them as complementary. And only few studies from Taraba State that have tested the two strategies together in a single piece of communication material specifically used for undergraduate students.

Engagement for the purposes of this study is the extent to which students could understand cognitive bias correctly and how they could relate it to their own personal experience after exposing them to the materials rather than as measure of attention or time spent with the content alone.

Statement of the Problem

Academic writing cannot be overemphasized especially when it comes to communication between scholars and experts but it is not the best way to provide good understanding among undergraduate students who comes across the concepts of behavioural science for the first time. And in Taraba State University just like in other institutions in Nigeria, undergraduate students basically come across this cognitive bias and other related concepts of behaviouralism through lecture slides and textbook definitions that focuses on content over clarity and that limits many students with just the surface knowledge instead of them working of how their own thinking can be distorted. Structured visual layout and narrative storytelling have been used separately and have shown to be capable of improving the comprehension of abstract scientific ideas but there is no much evidence of whether combining the two strategies in a single communication product can solve the problem for undergraduate students in Taraba State University. That is the problem this study want to solve.

Purpose of the Study

The purpose of this study was to examine how a two-page infographic combining structured visual layout with a short narrative influenced the engagement of undergraduate students at Taraba State University with information on cognitive bias. Specifically, the study seeks to:

i. Examine the influence of structured visual layout on undergraduate students' understanding of cognitive bias information;

ii. Investigate how storytelling affects undergraduate students' comprehension of and personal connection with confirmation bias; and

iii. Determine which combination of layout and storytelling produces the strongest engagement outcomes among undergraduate students at Taraba State University.

Research Questions

1. How does structured visual layout affect undergraduate students' understanding of cognitive bias information?

2. In what ways does storytelling improve undergraduate students' comprehension of and connection with confirmation bias?

3. Which combination of layout and storytelling produces the strongest engagement among undergraduate students at Taraba State University?

METHODOLOGY

The research design used in this study is the mixed method design as it collected a quantitative data using a 4-point likert scale and a qualitative data from open-ended questions at the same point in time and from same participants. This mixed method design was considered suitable to be used and get full information of how communication materials performed more than how one design would do (Creswell & Plano-Clark, 2018). It was a one group target used to collect enough data and did not involve any experimental approach, so it did not test any cause and effect between layout, storytelling and engagement just the way an experimental study would. This choice of research design directly aligns with the purpose of the study which focuses to evaluate how undergraduate students responded to a communication product that combined two strategies instead of using only one of the strategies. The study was carried out in Taraba State University and the population of the study was about 5,100 students from the three faculties of science, social science and humanities. And 30 students were sampled from the population using a purposive sampling technique which was considered appropriate since the goal is to gather different but meaningful data from different academic backgrounds. The sample was taken from three disciplines deliberately because cognitive bias is a relevant concept in all the fields and so getting feedback from this three fields gave a broader picture of how the materials performed more than a single field would provide. Participation was voluntary and the largest subgroup was the 300-level students at 46.7%, no observation checklist was used and students were informed about the purpose of the study before engaging in the materials. A communication product that was used is 2 page infographic that was designed in Canva and the first page introduced confirmation bias using a clear visual hierarchy which the title and central concept was emboldened and other supporting informations was chunked clearly into separated sections and white space was used in order to avoid visual crowding. While the second page showed an illustration of same confirmation bias concept using a short narrative about an imaginary undergraduate tagged Emeka, a figure who sought out information consistently in order to confirm his belief about an effective study technique but he ignored other evidences that contradicts his study. The story here was in a three parts structure of a situation, a problem caused by the bias and a moment of reflection which was just a one third of the total content so as to maintain balance between narrative and informational content. This materials were shared to respondents through a WhatsApp group and students were given unlimited time to engage them before completing the questionnaire. A structured questionnaire administered through Google forms and it was designed to align directly with the study's definition of engagement. This questionnaire was used to collect data or feedback and it had three sections: the first part contained a short-answer comprehension questions asking the students to define cognitive bias, then identify the bias shown in the story of Emeka, then relate confirmation bias to their own personal experience, and then explain the concept of confirmation bias in their own words. The second part of the questionnaire had 8 elements that was rated on a 4-point likert scale and it covered perceptions of layout clarity, the usefulness of the Emeka story, the total accessibility and their personal connection with the content. The 4-point likert scale of SA, A, D, and SD without a midpoint was deliberately used to encourage participants to take a position, and the third part contained two open-ended questions that asked students what they found most helpful about the materials and if anything was not clear or what they think could be improved. The questionnaire instrument was developed directly from the study's objectives and was reviewed for clarity and relevance for administration by 2 experts from the department of science education, Taraba State University. In scoring the questionnaire items, a comprehension responses was scored as full, partial or limited understanding based on whether the students

defined cognitive bias correctly and was able to identify confirmation bias in the story of Emeka accurately, while the open ended questions were read in full and grouped into themes by hand in order to identify recurring observations about the layout, storytelling and the whole communication experience.

RESULTS

Results are presented according to the three objectives that guided the study: the influence of layout on understanding, the influence of storytelling on comprehension and personal connection and the combined effect of the two strategies on total engagement.

Objective 1: Influence of Layout on Understanding

Table 1: Comprehension Outcomes Following Exposure to the Communication Materials (N = 30)

Comprehension Level	Criteria	n(%)
Full understanding	Correctly defined cognitive bias and identified confirmation bias in Emeka's story	22 (73.3)
Partial understanding	Defined cognitive bias or identified the story example, but not both	6 (20.0)
Limited understanding	Vague or incomplete response on both questions	2 (6.7)
Total		**30 (100.0)**

Table 1 shows that 22 (73.3%) students achieved full understanding, defined cognitive bias correctly and identified confirmation bias in Emeka's story accurately; 6 (20.0%) of the students showed partial understanding by just grasping either the definition or the story example but not both, and 2 (6.7%) students showed limited understanding even though these responses suggested at least a surface level understanding of the concept.

Objective 2: Influence of Storytelling on Comprehension and Personal Connection

Table 2: Likert Scale Agreement by Item (N = 30)

Item	Statement	Agreement
1	Layout made information easy to follow	90.0
2	Arrangement helped understanding of cognitive bias	93.3
3	Emeka's story made the concept clearer	93.3
4	Story helped connect concept to real life	93.3
5	Design made me want to read to the end	83.3
6	I feel confident I understand cognitive bias	86.7
7	Materials were easy to understand without extra help	80.0
8	I would recommend this to a fellow student	93.3
	Overall agreement	**89.2**

Table 2 shows that the two Likert items addressing layout on whether the arrangement made information easy for students to follow and whether it helped them understand cognitive bias, recorded an agreement of 90.0% and 93.3% respectively and this indicates that the structured visual hierarchy contributed meaningfully to how students received the content correctly; and the two Likert items that addresses storytelling direcly on whether the story of Emeka made the concept clear and whether it helped stidents connect the concept to real life, recorded the highest agreement in the entire set at 93.3% each. And this pattern was emphasised in the open-ended responses where the most frequent theme in all which was raised by 19 of the 30 students, was that the story improved clarity. 15 students went further to clearly describe a personal connection between the behaviour of Emeka and their own study habits or decision-making and this points to the students' comprehension and personal-relevance components of this objective. The remaining three items, that scored below 89% though still above 80%, concerned whether the design encouraged reading to the end (83.3%), whether participants felt confident in their understanding (86.7%) and whether the materials were easy to follow without extra help (80.0%).

Objective 3: The Combined Effect of Layout and Storytelling on Engagement

The open-ended questions focused on collecting information of the combined effect of the strategies on the total engagement by students on the material. In the response of seventeen students, they frequently noted that the visual organisation made it easy for them to know where to look and how the sections related to one another and their comments mostly focused on the clarity of the structure than on the decorative appeal. The item that asked students whether they would recommend the materials to a fellow student which points to the total judgement of the combined product instead of either of the strategies recorded agreement of 93.3% and this shows the highest individual scores for both layout and storytelling. Eight students asked for additional story examples covering other types of bias introduced on the first page and this suggests that the combined format generated appetite for more rather than fatigue, while five students noted that the definition text was difficult to read on a phone screen which is a practical accessibility concern given that the materials were distributed digitally.

DISCUSSION

The finding that 73.3% of students got full understanding after a one time exposure to the infographic suggests that a communication materials designed well can produce meaningful comprehension gains without classroom instruction or follow-up discussion amd this result aligns with Tanaka and Tse (2022) who showed that undergraduate students who were given structured visual layouts had significant scores on comprehension tests more than the students given the same content as a plain text. The current study aligns in the sense of consistent pattern since it didn't compare groups performance. The agreement scores on the two layout items at 90.0% and 93.3%, point in the same direction as Tanaka and Tse's results and support the explanation that a clear visual hierarchy can reduce the effort readers put in locating and ordering information thereby leaving more capacity for processing the substance of the message itself. This explanation illustrates the cognitive load theory (Sweller, 1988) which believes that the working memory is limited and so poorly organized material consumes the memory capacity that would otherwise support stronger understanding. The strong performance of the storytelling items both at 93.3% agreement and the most frequently cited theme in the open-ended responses supports Vaughn et al. (2022) who found that the use of narrative formats can produce stronger personal relevance ratings than expository formats especially for abstract concepts and the present finding extends this pattern to a Nigerian undergraduate sample and specifically to confirmation bias. A good narrative aligns with the idea of narrative transportation described by Appel and Mara (2021) who showed that a story allows a reader to encounter a realization that is not comfortable especially as their own thinking may be biased, they can see this through indirect imaginary character instead of having a direct accusation. This style of indirect approach does not face much resistance from students to the idea and it is made easier for students to recognize the same pattern in themselves. Joubert et al. (2019) argued that narratives engage emotional and cognitive processing at the same time and the present data aligns with that argument even though their work is conceptual and not an empirical comparison and should be read as giving a sound mechanism instead of independent confirmation.

The comprehension and Likert findings together suggest that layout and storytelling did not simply add to one another but worked through different routes towards the same outcome. Layout appears to have lowered the barrier to engaging with the material at all, consistent with the idea that reduced cognitive load increases the motivation and ability to process content carefully, a condition the Elaboration Likelihood Model identifies as necessary for central-route processing (Petty et al., 2019). Storytelling in turn appears to have supplied the personal relevance that made the concept worth processing carefully once the barrier was lowered. This division of function would explain why the three lowest-scoring items, all related to independent comprehension without extra help, clustered together: layout and story made the material approachable but a small proportion of students still wanted support beyond the infographic itself, and this pattern also reflected in the eight students who asked for further story examples.

The finding that five students struggled with text size on a phone screen is a smaller result but is important in practical sense because it emphasises a concern raised by Mutua and Mwangi (2021) regarding visual design and cognitive load in digitally delivered learning materials in East African university, where screen variation among learners receiving the same digital content was identified as a source of inconsistent comprehension outcomes. The present finding suggests this concern is shown in the materials distributed through WhatsApp among the undergraduate students in Taraba State University and is a design consideration rather than a flaw in

the underlying communication strategy. Three limitations affect how these findings should be read. First, the absence of a comparison group means the results describe how this audience responded to the combined materials rather than demonstrating that the combination outperformed either strategy in isolation; the conclusion that layout and storytelling work well together is shown on the convergence between the quantitative and qualitative data rather than on an experimental contrast. Second, the sample of 30 students from one university limits generalisation to other institutional settings, as also noted by Nwosu and Okonkwo (2022) regarding variation in science communication outcomes across Nigerian universities. Third, the absence of a delayed comprehension check means the findings speak to immediate understanding rather than retention over time.

Implications for Science Education

These findings have several implications for science education practice in Nigeria and beyond: in the classroom practice the results suggest that how a science concept is laid out on a page or slide is not a cosmetic detail but a factor that shapes whether students process the material carefully or only superficially. So teachers introducing abstract ideas such as cognitive bias, or comparable abstract concepts in other branches of science, may benefit from organising material with clear visual hierarchy and chunked sections rather than dense, undifferentiated text especially when introducing a concept for the first time to students.

The strength observed in the storytelling findings shows how a major classroom took is under used. If used well, confirmation bias and similar abstract concepts become more easier to grasp when embedded in a short, relatable narrative instead of being presented only as a formal definition. Science teacher preparation programmes could give this strategy more direct attention, since many teachers rely on definition instruction method may be because they have not been shown how to construct a brief illustrative narrative around a concept. So training student teachers to write short, concept-specific stories as a routine planning step alongside more familiar strategies such as demonstration and questioning, would equip them with a low-cost tool supported by this and prior evidence.

For curriculum development, the consistent gap this study found between abstract presentation and genuine understanding suggests that curriculum documents in behavioural and social science topics should explicitly encourage narrative and visually structured materials instead of just leaving the format entirely to individual teacher discretion. Where cognitive bias or related reasoning concepts appear in science, psychology or general studies curricula, guidance on communicating them accessibly would help ensure the concept is understood rather than just covered.

On educational policy, institutions distributing learning materials digitally which is a practice that has become routine in Nigerian higher education, should treat mobile readability as a basic design requirement rather than an afterthought. The text-size concern observed by a minority of students in this study is a reminder that materials designed on a laptop screen do not automatically transfer well to the screens most students actually use. So policies on digital course material development could include a simple check on readability on mobile before materials are distributed.

Regarding technology integration, accessible design tools such as Canva and PowerPoint as used in this study have shown that producing visually structured, narratively engaging materials does not require specialised graphic design training or expensive software. This lowers the barrier for teachers and curriculum developers wishing to adopt these strategies and suggests that capacity building in this area is realistic within existing institutional resources.

Future research would benefit from a quasi-experimental design that compares layout, story, and combined versions of the layout and story content against a plain text control, which would allow the independent and combined contributions of each strategy to be separated with more confidence than the present convergent descriptive design allows. So studies involving larger and more diverse samples across multiple Nigerian institutions, together with delayed comprehension assessments, would also help establish how well understanding gained from such materials is retained over time and how consistently these findings hold beyond a single university.

CONCLUSION

The purpose of this study was to examine how visual layout and storytelling influenced the understanding of undergraduate students when used together in connection to confirmation bias. The findings of this study was gathered using a two page infographic that combines structured layout with a short narrative and it produced strong comprehension with nearly a three quarters of students showing full understanding after a one time exposure to the materials, the findings also showed a strong perceived value with highest agreement scores attached to especially the storytelling elements. The layout was shown to have made the material more appealing and approachable by making students' efforts easy in processing it while the storytelling supplied the personal relevance that made the concept feel worth u see standing instead of just worth reading. But neither strategies alone would have produced the same result of comprehension and personal connection observed in this study and the combination of quantitative and qualitative data across the two strategies supports this conclusion. The findings also emphasises that confirmation bias especially because it is a pattern most people recognize in themselves once it is explained clearly, was a well chosen subject for this kind of communication design

RECOMMENDATIONS

The following recommendations are made following the findings of this study: science communicators and educators preparing materials on abstract or counterintuitive concepts should treat layout decisions including visual hierarchy, chunking and white space as a primary part of material design instead of just as a finishing step applied after content is written. Storytelling should be adopted more deliberately as a standard instructional strategy for abstract behavioural and social science concepts with short and narratives of specific concepts constructed around relatable student situations. Science teacher education programmes should include explicit training in constructing brief illustrative narratives and structuring visual layout since both can be taught as practical skills instead of leaving it to individual aptitude. Institutions distributing digital learning materials should test those materials on mobile screens before distribution given that text legibility on phones was the most consistently raised concern in practical sense in this study. Finally, future studies should adopt a comparative design that tests layout, story and combined formats against a plain text version of the same content, ideally across multiple institutions and with a delayed comprehension measure in order to establish more precisely how much each strategy contributes on its own and how durable the resulting understanding is over time.

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