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RESEARCH PAPER

Genre and Multimodal Literacies: Analyzing Design and Usability of School Textbooks in Pakistan

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ABSTRACT

This research paper explores the organization and layout of multimodal resources in secondary-level English medium social science and pure science textbooks used in Pakistani schools. The purpose of the study is to describe the differential use of multimodal resources and the rhetorical patterns of the page layouts of the textbooks of social sciences and pure sciences. Criterion sampling techniques were used to select textbooks. The data was analyzed using Bateman's GeM (Genre and Multimodality) framework. The findings show the configurational nature of the multimodal artefacts and the categorization of the multimodal resources into page-flow and text-flow. The findings provide insights for textbook publishers, syllabus designers, and teachers in developing effective multimodal artefacts for English medium school learners.

Introduction

Multimodality refers to the convergence of multiple modes, like visual, verbal, gestures, graphs, etc., in texts for meaning-making (Jewitt et al., 2016). Due to the rapid rise of digital technologies, modern-day communication is rarely mono-modal; nowadays, it takes multiple modes to construct an artefact, such as text, image, sound, diagram, symbol, etc. Research in inter-semiotic cohesion in multimodal artefacts has shown that combining these visual and verbal resources is dynamic and complex (Khalid et al., 2017). Similarly, many scholars working on different text types have also focused on exploring the generic layouts of the multimodal resources and their intricate relationship with the communicative goals of the artefacts. The objective of the current study is to unearth the orchestrated and generic nature of the combination of modes used in the textbooks. We believe that current pedagogical content used in the classrooms is dominantly multimodal, potentially involving the 'multiplicity of meaning (Lemke, 1998). Therefore, there is a need to research how multimodal meanings are presented, interpreted, and communicated in the classrooms. The

multimodal presentation of the study material in textbooks demands a certain level of multimodal competence among learners to interpret multimodal grammar for meaning-making (Royce, 2002). In this context, the traditional teaching approaches need to be changed in favour of multimodality-informed pedagogical practices (Araneda & Fredes, 2021).

Rapid technological improvements have allowed educators to combine reading and writing with other forms of media. Literacy is the ability to read, view, write, design, speak, and listen in a way that allows communication possible. Multimodal literacies require multimodal competency for interpreting meanings. Outside the classroom, there are numerous ways adults and children incorporate multimedia into their daily lives through Facebook, blogging, Twitter, YouTube, and Flicker, to name a few. Their exposure to these multimodal media helps them develop their multimodal competence. The use of multimodal teaching materials may capture the learners' attention and potentially engage learners in the learning process.

Nonetheless, in classroom settings, teachers are not well-trained to use multimodal materials in teaching effectively. Additionally, multimodal material can be used to explain complex concepts in class, and its use may provide multiple creative opportunities for teaching and learning. Students find fantastic technology in the classroom, allowing them to express their learning through the creative forum to interact with their peers and the greater community (Moreno & Mayer, 2007).

In the science classroom, multimodality is already evident in using laboratory experiments and demonstrations to convey learning content. It is now time to expand the existing multimodality of the science classroom into multimedia. Developing real-world interactions are only sometimes easy and sometimes impossible. Computer simulations can bridge this gap and provide entertaining interactions to students developing an understanding of the concept. For instance, in Australia, the simulations are used for glaciers. This simulation shows that raising the sea level temperature by point one degree dramatically reduces the glacier's size.) Such simulations allow students to engage directly with the environmental issues and the impact of climatic changes on the glaciers.

Literature Review

Admittedly, several studies have explored the use of multimodal resources in teaching materials; nonetheless, many aspects of multimodal literacies require further research to mitigate the research gaps. One such area is the generic organization of the multimodal resources on the textbook pages. This exploratory research analyses different semiotic modes present in textbook layouts at the secondary level in English medium schools in Pakistan. This section presents a comprehensive review of the relevant literature, serving as the methodological and theoretical foundation for the study. The literature review focuses explicitly on incorporating genre and multimodality in research. Notably, Bateman et al., (2017) have emphasized the significance of multimodality by deconstructing multimodal artefacts into three

essential components: medium (material), mode (semiotic modes), and genre (strata of organization). Bateman et al. (2017) state that medium as a socially and historically constructed practice, semiotic modes contribute to the medium and acknowledge significance through their material or 'virtual canvas' and their semiotic side.

According to the GeM framework, the notion of a medium can be discussed as a material made up of concrete physical substance on which the whole document relies and has achieved an established form over time. Furthermore, its consumption and production remain constant, and if the material successfully fulfills some communicative tasks, it may be called a "full-blown medium." This research uses secondary-level textbooks as a medium for investigation, owing to their considerable value and relevance within the academic context under examination.

The second key concept within the GeM framework is that of mode. Mode plays a central role in multimodal research; the notion of "mode" is theorized as a transitional category amid the large and small-scale semiotic modes (Bateman 2014). Mode has both a material form and a semiotic form; the former deals with canvases and sub-canvases, whereas the latter deals with the meaning associated with the canvases and sub-canvases. In the GeM framework, different methods are proposed for delineating the various types of semiotic modes; but this research has delimited itself to the investigation of "semiotic modes" in the page-based textbook documents.

Bateman (2014) discusses genre as a "second-order phenomenon: a patterning of patterns, a phenomenon which cuts across different strata of organization." (p. 243). In language, the genre is marked by the lexico-grammatical choices and the unique discourse patterns present at the schematic level of the multimodal documents. Different researchers have established that genre features are closely determined by the context of its production and communicative goals. Miller (1984) suggests that learning a genre means learning different linguistic forms, conventions, and ways to participate in communicative actions. Swales (1990) considers genre as a discourse that aims to achieve communicative goals through "socio-rhetorical" writing activities. Bhatia (2002) proposes analyzing the genre, investigating the other specific field of study, and interpreting and achieving the community goals of writing the genre. So, the function of genres is to characterize the communicative purposes they fulfill. Bhatia (2012) claims that the early form of genre studies mainly focused on assisting teachers to explore their pedagogic skills while teaching English to ESP students, latter with the advancement in research and teaching, genre studies became a successful tool for analyzing academic and professional genres, for about more than thirty years (Usman et al. 2019). Furthermore, according to Deng, Chen, & Zhang (2014), international students should not only have "genre knowledge" of one genre or sub-genre as well in order to have better genre-based competence in various academic fields of study.

The formative model of the Genre and Multimodality (GeM) framework formulates its base on three key concepts; medium, mode, and genre. Genre performs a central role in Bateman's (2008) and Bateman et al. (2017) models, but Bateman is not

successful in providing a comprehensive definition of genre in the models as mentioned earlier. Bateman accepts this limitation by acknowledging; the genre is still a vague term, and it is open for empiricists to ensure the availability of a broad range of genre documents (Bateman 2014).

A multimodal textbook can be defined as an educational resource utilized in academic settings; which engages with its readers through multiple modes of representation, such as text and images. Comprehending meaning in contemporary educational materials requires examining linguistic elements and a variety of semiotic resources that operate independently and in conjunction with one another (Kress & van Leeuwen, 2001). The current research examines the various semiotic modes (text and images) present in the layout of secondary-level textbooks in English medium schools in Pakistan. School textbooks aim to develop students' literacy, which a variety of means, including language, images, graphs, gestures, and more, can enhance. According to Jones (2006), learners integrate the meanings of several resources, including visual, linguistic, gestural, and aural ones. As a result, literacy does not just refer to vocal literacy; instead, literacy instruction is mainly based on the written transcript (Kress, 1997; Lemke, 1998).

In order to learn more about visual grammar, Kress and van Leeuwen (1996) examined science schoolbooks that include images, sketches, graphs, and diagrams. The researchers have explored in this study that there has been a significant change from verbal mode to visual mode in textbooks under analysis in recent years, in which the visual modes have become more dominant to make the content more interactive and collaborative. Researchers did it by analyzing the implication of visual features of the textbooks used in secondary schools of a course taught for a long time without any change. In order to make students good readers and create more visuals, it is necessary to systematically reform educational methods, mediums, and modes as science shifts from verbal to visual modes. In a subsequent study, Kress (1997) also explored science textbooks and discovered that the role of the visual and verbal components had changed. The results show that earlier textbooks mainly focused on verbal information and that visuals played little part in conveying new knowledge due to some constraints mentioned by Bateman (2008), like canvas and production constraints. In his proposal, he offers "an example of a new code of writing and image, in which information is transported by the two modes differently" (p. 65).

Several other studies have explored the use of multimodal resources in textbooks. For instance, O'Halloran (2009) has used insights borrowed from Systemic Functional Linguistics to conduct an SFL-based multimodal analysis of literacies in mathematics. Similarly, Liu and Qu (2014) have examined the use of multimodal resources in the textbooks used in Chinese colleges. They demonstrate how different strategies are used for establishing inter-semiotic cohesion in the textbooks and how using multimodal resources might challenge the understanding and learning of students with low English language competence. Another study conducted by Parlindungan et al. (2018) comparatively studies the differential use of multimodal resources in textbooks for middle school students. With its Focus on the representation

of Indonesian culture in the textbooks, the study shows how cultural values, socio-political discourses, and cultural ideologies are discursively presented through multimodal resources. Teo and Zhu (2018), have studied the use of multimodal semiotic resources in Chinese EFL textbook for the presence of the appraisal system. They demonstrate how visual and verbal resources can be used to create positive appraisal meanings to emphasize the nationalist feelings among Chinese learners by semiotically promoting the Chinese cultural conventions and practices. The study is unique in its methodology as it borrows insights from the appraisal theory and visual grammar to achieve the research objectives.

Material and Methods

The researcher has used an Exploratory qualitative research design for the current study. For this multimodal research, researchers use page-based documents selected from the school textbooks of secondary-level English medium schools. These textbooks were divided into two groups, i.e., textbooks of pure sciences (Physics and Biology) and textbooks of social sciences (English and Social Studies). The purpose of the study was to describe the differential use of multimodal resources and the rhetorical patterns of the page layouts of the textbooks of social sciences and pure sciences. It is important to mention that multimodal resources vary from lesson to lesson and discipline to discipline. Mostly, it depends on the nature of the topic given on a textbook page that determines the layout of the page. For instance, the layout of a page that elaborates on the respiratory system can be quite different in its organization of multimodal resources than the page giving activities and questions on the same topic. Due to this variability, any random sampling technique might not have been able to achieve the research objectives. Therefore, the researchers have used the criterion sampling technique and have selected only those pages for analysis that a) present the core topics of that field and b) have more than 15% of the covered area of the page with an image or infographics. Furthermore, the researchers used the proportional allocation criterion to proportionally select the images from each textbook depending on the textbook size (measured in terms of the number of images in the textbook). By applying these sampling techniques, the researchers selected the following number of multimodal pages from the selected textbooks used at the secondary level in Pakistani English medium schools:

Table 1
Data Scheme and Sample Size

Textbooks	Number of Multimodal Pages
Pakistan Studies	18
English	23
Physics	27
Biology	32
Total images analyzed	100

Theoretical Framework & Analytical Procedure

The study analyzed selected 9th-grade textbooks in Pakistan, specifically those developed by the Punjab Curriculum and Textbook Board following the National Curriculum Framework 2006 guidelines supervised by the National Curriculum Council (NCC). The NCC is a national coordinating body comprising three members from each province/area, aiming to achieve national educational goals and ensure curriculum uniformity under the Ministry of Federal Education and Professional Training, Pakistan.

Bateman (2008, 2009, 2011) and Bateman et al. (2017) have developed a toolkit to analyze the selected content from the textbooks, which offers a systematic approach to textbook analysis, encompassing the investigation of layout structure, genre, and different semiotic modes functional in the page-based documents of textbooks. To investigate the organization and layout of multimodal resources used at the secondary level English medium schools of Pakistan, selected social science and pure science textbooks are analyzed using a modified Bateman et al. (2017) Genre and Multimodality model into GeM-SAT (semiotic analysis of textbooks through genre and multimodality) framework, specifically designed for the analysis of the semiotic modes present within page-based documents of the selected textbooks, considering both text-flow and page-flow.

Results and Discussion

In connection to curriculum, school textbooks play a crucial role in providing information and knowledge and shaping students' educational experiences. The teaching content in Social and Pure science textbooks is extensively used in multimodal textbooks that enhance its directory of dealings. There is a usability of diverse multimodal resources in images, graphs, diagrams, and texts to profoundly convey valid and reliable information. The text- flow develops a linear approach in the presentation of information; moreover, there is a profound sequential order, which allows the reader to read from the very start till the end with some logical and coherent knots. This approach aims to present information more systematically and suitably, in line with maximum textbooks with a chain of conceptual developments. Such an approach deals with various subjects, including Pakistan Study, English from Social Sciences, Physics, and Biology from Pure Sciences. There is a semiotic analysis of text-flow in multimodal textbooks from Pakistani English medium schools. The GeM-SAT approach is utilized in this analytical mode to find the textbook's text-flow. The GeM-SAT approach explains a systematic semiotic analysis of Textbooks through Genre and Multimodality. This framework highlights the features of page layout, color, typography, and other semiotic means and becomes a structured mode for researchers to analyze various multimodal aspects of textual glimpses.

Social Science Textbooks: Text-flow, Page-flow

There is the display of variations from textbooks of social sciences in the form of text-flow and page-flow in table number 2. However, the text-flow in Social Studies and English textbooks is arranged and organized in written language, which proceeds

linearly. As the presented information depends on the author's intended goals for the book, text-flow, and page-flow conceptions are deployed in the Social Sciences textbooks. Within the text's linear format, diagrams and pictures may be used. This follows the conventional structure of academic textbooks, where the information is presented sequentially. On the other hand, social science textbooks do not follow visual design concepts, including proximity, grouping of pieces, framing, and other visual perceptive features.

Table 2
Social Science Textbooks: Text-flow, Page-flow

Social Science Textbooks	Text-flow	Page-flow
Social Studies, English	In the social science textbooks, the semiotic mode of text-flow is characterized by the linear structure of the written language; moreover, most of the images and infographics are linearly structured and the page space is not fully utilized to make complex multimodal meanings (see Bateman et al., 2017, p.270).	Social Science textbooks organize semiotic motes into larger units of meaning. The paragraphs, infographics, textboxes, etc., are the larger units of the page and the semiotic mode page-flow structurally organizes these larger units for interpretation.

Pure Science Textbooks: Text-flow, Page-flow

The differences in text-flow and page-flow of pure science textbooks can be observed in Table 3. In Physics and Biology textbooks, text-flow follows the principle of linearity, but it is not solely built around written language, and the structure of the text does not strictly unfold linearly. In contrast, page-flow in pure science textbooks departs from linearity and incorporates principles such as proximity, grouping of elements, framing, and other visual perceptual resources. This approach aims to construct patterns of connections, similarities, and differences across the layout space. Page-flow in pure science textbooks is a composite semiotic mode that combines contributions from other semiotic modes and organizes them into larger units within the layout. This indicates a more visually structured and interconnected layout than pure science textbooks' linear text-flow approach.

Table 3
Pure Science Textbooks: Text-flow, Page-flow

Pure Science Textbooks	**Text-flow**	**Page-flow**
Physics, Biology	The semiotic mode of text-flow in pure science textbooks shows that the principle of linearity is	Page-flow shows that in contrast with the page layouts of the social science textbooks, pure

	observed. Moreover, this semiotic mode uses more page space on the pages to give dense and complex multimodal meanings. It was also found that in purse science books text-flow and infographics were closely integrated through the use of inter-semiotic connections	science textbooks group semiotic elements of infographics, text, paragraphs, etc. Furthermore, this grouping is complex and requires the use of certain textual and visual perceptual strategies for interpreting meaning. This compositional organization of larger units of meaning makes maximum use of the layout space (see Bateman et al., 2017).

Organizational Structure of Social Science Textbooks

The organizational structure of social science textbooks, as depicted in Table 4, reveals several characteristics. In terms of organizing principles, social science textbooks operate linearly, supporting the activity of reading through text-flow. Typographically, these textbooks contain more text and fewer images. Additionally, the images in the textbooks may need to be labeled appropriately, and their size tends to be more significant. In terms of spatial coverage, the content spans from top to bottom and from the left-hand side to the right-hand side, with minimal compartmentalization. The recognition and allocation of canvases and sub-canvases to different semiotic modes in social science textbooks are straightforward, focusing on simple semiotic modes. Consequently, social science textbooks contain fewer images and rely more on descriptive text to convey information.

Table 4
Organizational Structure of Social Science Textbooks

Social Science Textbooks	
Social Studies, English	
Organizing principles operating on the surface of each textbook	**Linear** Supporting the activity of reading (related to the semiotic mode of text-flow).
Typographic	With more text and fewer images, the images need to be labeled appropriately. Mostly, the size of the images is also bigger.
Coverage of spatial region	Coverage of spatial region from top to bottom, from the left-hand side to the

	right-hand side is observed. Semiotic mode of page-flow rarely structures larger units of meaning in complex arrangement.
Recognition and allocation of canvases and sub-canvases to different semiotic modes	Simple semiotic modes are used. Fewer images and more textual description is given

Organizational Structure of Pure Science Textbooks

Table 5 shows the organizational structure of pure science textbooks. Pure science textbooks use the spatial organization as their organizing concept and encourage students to combine the composition's numerous parts. A compartmentalized structure that adheres to the idea of page-flow supports this non-linear approach. Pure science textbooks include less white space between the lines of text and less labeling on the illustrations. With a focus on compartmentalization, the content is spread across the entire page regarding spatial coverage, from top to bottom and left to right. Pure science textbooks use a wider range of semiotic modes, making it more difficult to identify and assign canvases and sub-canvases to various semiotic modes. As a result, pure science textbooks include more images, presenting challenges and fostering creativity among students.

Table 5
Organizational Structure of Pure Science Textbooks

Pure Science Textbooks	
Physics, Biology	
Organizing principles operating on the surface of each textbook.	**Spatial** Encouraging the students to put together the parts of the composition. Page-flow is non-linear due to compartmentalized structure, that gives complex compositional meaning to the text.
Typographic	Space between the lines and text is less which makes the page-flow denser and less linear. Images are appropriately labeled and inter-semiotically integrated with the texts.
Coverage of spatial region	Coverage of more spatial region is found. Larger units of text and infographics give a compartmentalized structure to the page-flow
Recognition and allocation of canvases and sub-canvases to different semiotic modes	Complex semiotic modes More images, challenging, creative

Conclusion

Bateman (2008) considers text-flow and page-flow as semiotic modes that give the multimodal layout to the textbook pages. Comparative analysis of the multimodal strategies used for projecting page-flows and text-flow on the 100 selected multimodal pages shows that social science textbooks have a linear structure, and they less frequently use the principle of proximity, framing, and other visual perceptual elements. On the other hand, pure science textbooks generally have a non-linear structure, and their page-flow covers spatial regions more comprehensively than the textbooks of social sciences. Furthermore, no significant difference was found in the social sciences and pure science textbooks in terms of their allocation of canvases and sub-canvases to different semiotic modes. It was also found that the semiotic modes had more multimodal density for pure science textbooks than that of social science textbooks. Following Bateman et al., (2017), this could be related to the high-ability and low-ability of the learners to interpret multimodal meaning from the texts.

Previous research (Bateman, 2008, 2009, 2011) suggests that social science students are often perceived as low achievers; thus, they may benefit from less complex layouts and simple text-flows. It is recommended that learners with low multimodal competence may be exposed to the learning material in simple text-flows to facilitate their information processing. Teachers may explicitly discuss the genre-based multimodal composition of the textbook pages at the beginning of their lessons to develop multimodal literacies and competence among learners. In this regard, the teacher may use a collaborative learning approach and allow the learners to reflect and discuss their challenges in interpreting multimodal texts. Scaffolding is another technique that may encourage students to conduct genre-based multimodal text analysis. There is a need to use teaching practices in our classrooms that aim at developing the multimodal competence of the learners (Coccetta, 2018; Sinaga & Suhandi, 2015).

Recommendations

Based on the findings of this research paper, several suggestions can be made to enhance the organization and layout of multimodal resources in secondary-level English medium social science and pure science textbooks.

Firstly, it is crucial to analyze the page-layout from a multimodal perspective. Understanding how different semiotic modes contribute to meaning-making is essential. This analysis finds that different genres have different organizational structures based on the subject's requirement, topic, level of students, and student learning outcomes.

Furthermore, creating effective page layouts is crucial. The user experience can be greatly improved and communication improved by strategically placing and

arranging multimodal content. In order to keep the students motivated, persuaded, and engaged, it is necessary to switch from traditionally page-based documents to digital material such as web-based material, blogs, vlogs, and recorded lectures. Studies show that students are more comfortable with digital material than 2D page-based documents.

Students should be taught according to their aptitude from an early level rather than teaching all the subjects without checking their interests, inclination, and aptitude. Considering the target audience is also vital. Pure science textbooks, designed for high-ability students, incorporate multimodal content that is strategically placed across the page (page-flow). Recognizing the students' ability to assimilate and engage with such content is essential for tailoring the layout to their needs and abilities.

In conclusion, analyzing page-layout from a multimodal perspective and designing efficient layouts are crucial for effective communication and an enhanced user experience. Tailoring the organization and layout of multimodal resources to meet the needs and abilities of high-ability students in pure science textbooks is essential. By examining the layout's spatial arrangement, researchers can understand how different semiotic modes contribute to meaning-making within the page-layout. These suggestions can guide future efforts to improve the educational materials used in secondary-level English medium social science and pure science education.

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