

# Development for the Digital Picture Book of T'ien-kung K'ai-wu for Lower Grade Students Guided by the Multi-modal Theory

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## Abstract

This study analyzes the characteristics of the existing printed picture books of T'ien-kung K'ai-wu under the multi-modal theory, and proposes the design strategy of the digital picture books of T'ien-kung K'ai-wu suitable for lower grade students (6-8 years old) so as to improve the transmission rate of T'ien-kung culture in this group. By adopting the method of questionnaire survey, this study learned about the design needs of lower grade students for the printed picture books of T'ien-kung K'ai-wu, and selected representative pain points of needs to serve the strategy development of digital picture books. The strategy of the printed picture book of T'ien-kung K'ai-wu is proposed in three aspects: vision, hearing and touch. Visually, it is composed of three major factors: picture matching, text and typesetting; audience presents the book content with voice; tactile interaction is mainly realized by clicking, sliding and other actions. The mode of multi-sensory interaction provides the possibility of two-way viewing for digital picture books, thus bringing readers an immersive reading experience.

## Keywords

Multi-modal; T'ien-kung Culture; Digital Picture Books; Lower Grade Students.

## 1. Introduction

As an important way to absorb the inheritance of human civilization and individuals' independent learning of culture, reading plays an irreplaceable role in children's enlightenment education.[1] Picture books refer to materials suitable for children's reading and appreciation. A high-quality picture book usually integrates aesthetics, knowledge and ideology, and plays a positive role in cultivating children's imagination, creativity, emotional perception and aesthetic ability. [2] The research subject of this paper is lower grade students, specifically referring to the primary school students in the first and second grades. The age range of this group is 6-8 years old. Therefore, based on the cognitive ability of the lower grade students, this study will apply the multi-modal theory to the strategy development of the digital picture book of T'ien-kung K'ai-wu, which will help readers understand the content of the picture book of T'ien-kung K'ai-wu in a more intuitive manner.

## 2. The Multi-modal Theory and the Digital Picture Book of T'ien-kung K'ai-wu for Lower Grade Students

### 2.1. An overview of the multi-modal theory

"Multi-modal" refers to the integration of two or more modes. It refers to interaction with the external environment through different media channels, means and resources, which act on people's vision, touch, hearing, smell, taste and other perception channels.[3] Through more diversified forms of interaction and the cooperation of different perceptual channels, the

subject can be more immersed in the current behavior and activities, his/her multi-perception ability will be cultivated, thus forming a dynamic and unified cognitive structure of cognition, body and environment. [4]

## 2.2. The application status of the multi-modal theory at home and abroad

Compared with domestic researchers, their foreign peers apply the multi-modal theory more widely. Lasisi Ajayi et al. studied the different manifestations of multi-modal texts on students' self-identity and visual images under the interaction of social and cultural worlds, and used the social symbol framework proposed by Kress and van Leeuwen to study the importance of multi-modal availability.[5] By integrating multi-modal teaching methods into the practice of the course "Teenagers' Literacy Methods", Mary Thompson et al. encouraged students to establish new ways of thinking. [6]At the same time, influenced by the research on the multi-modal theory, domestic researchers have gradually begun to apply this theory to the development of children's picture books. Zhou Li et al. used systematic functional multi-modal discourse to study the interrelationship between modes, and explained the functions and interrelationships of the three modes in children's picture books, namely picture, text and sound [7]; Gui Yi et al. elaborated on the interaction of language and images in English children's picture books in the overall meaning construction of the text [8].

To sum up, for students, the multi-modal theory often plays its role through the combination with textbooks, picture books or teaching activities, and can achieve two-way communication between research samples and objects. Therefore, it is of great significance to apply the multi-modal theory to the development of digital picture books of T'ien-kung K'ai-wu.

## 2.3. Investigation on the status quo of the domestic market of printed picture books of T'ien-kung K'ai-wu

T'ien-kung K'ai-wu was written by Song Yingxing living in the Ming Dynasty. It consists of three volumes and eighteen chapters, containing production technologies, tools and raw materials related to agriculture and handicraft industry. Reputed as "China's Encyclopedia of Crafts in the 17th Century", it has great dissemination value. However, the profound content of T'ien-kung K'ai-wu is difficult for children to understand, so children's printed picture books with T'ien-kung K'ai-wu as the content have emerged in the market.

According to the printed picture books of T'ien-kung K'ai-wu available on online shopping platforms, the author has found that the printed picture books of T'ien-kung K'ai-wu currently sold in the market are mainly books published by three different publishers (Table 1). There are differences between these picture books in their ways of content expression and the drawing styles, as well as their target groups. On the whole, however, in the development of picture books in the field of T'ien-kung K'ai-wu or "T'ien-kung culture", there are few options and a serious phenomenon of homogenization. Parents can only choose picture books for their children from a fixed number of publishing houses. For consumers, their needs cannot be effectively penetrated into picture books, while for the publishing houses, the printed picture books of T'ien-kung K'ai-wu cannot be competitive in the market.

Secondly, there are difficulties in the dissemination of comprehensive works such as T'ien-kung K'ai-wu, which focuses on agriculture and handicrafts, among the lower grade students. If the picture books are not vivid and flexible, and cannot match the cognitive level of lower grade students, it is more difficult for them to stimulate the interest of the lower grade students in reading them, which will greatly lower the dissemination rate of T'ien-kung K'ai-wu among lower grade students. Therefore, based on the multi-modal interaction theory, this study aims to apply the proposed design strategy to the digital picture book of T'ien-kung K'ai-wu in combination with children's psychological cognitive characteristics, systematically give lower grade students a new reading experience from a multi-sensory perspective, provide them with

better interaction modes and learning methods, so as to better spread and inherit the “T'ien-kung culture”.

**Table 1:** Available printed picture books of T'ien-kung K'ai-wu in online shopping platforms

Cover of the picture book			
Picture style			
Layout of pictures and texts			
Publishing house	CITIC Publishing Group	People's Posts & Telecom Press	Inner Mongolia Culture Publishing House
Target group	Young children aged 4-10	Young children aged 5-9	Children aged 10-12
Monthly sales volume	100+	42	400+
Price (Yuan)	46	62	19.8

### 3. Strategy development of digital picture books of T'ien-kung K'ai-wu for lower grade students

Electronic picture books are a combination of two concepts: "e-books" and "picture books". In a certain sense, e-books refer to static digital versions of printed books, or electronic screen books designed to facilitate handheld reading. [9] At the same time, according to the trend of the times, digital picture books will become a trend in the future. They will have a certain impact on traditional printed picture books, and will bring substantial changes to them.

### **3.1. The characteristics presentation of the multi-modal theory in the printed picture book of T'ien-kung K'ai-wu**

#### **3.1.1. Vision**

Vision is an active and selective exploration of the human body, which can select all things that are seen. [10] Especially for lower grade students aged 6-8, their perception of patterns is becoming stronger, and vision has become the main means for them to perceive picture books. Compared with abstract shapes or objects, they have deeper memories of specific objects and their shapes and colors. [11] According to the printed picture books of T'ien-kung K'ai-wu listed in the market survey as shown in Table 2-1, the visual characteristics under the multi-modal theory can be measured from three perspectives: picture, text and layout design.

When lower grade students first see a new picture book, they will first observe its cover. The cover is the abstract and general expression of the whole picture book, covering three elements: picture, text and layout; secondly, the colors, character images, character demeanor, actions, scene compositions and other visual perception brought by the large area of pictures in a picture book, as well as the font, size, thickness, color and other elements of the text in the narrative, and the layout order and position of the font content and pictures are all important design factors for the visual presentation of the picture book.

#### **3.1.2. Hearing**

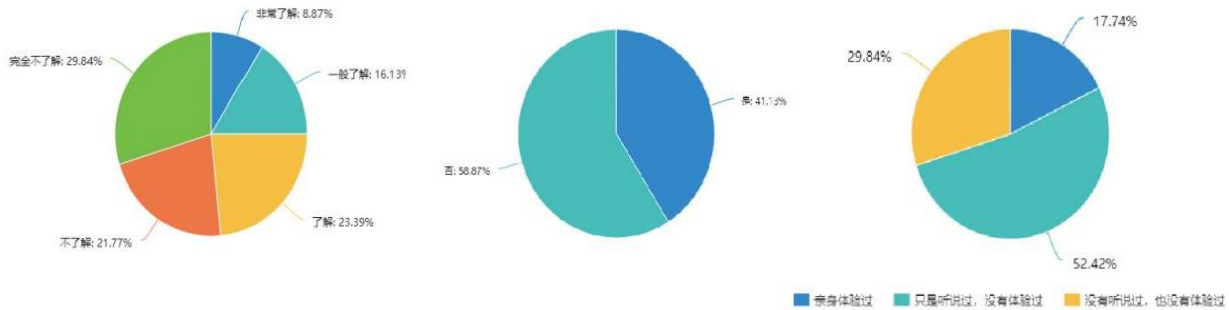
As the second largest sensory organ after vision, hearing can directly affect the emotion of lower grade students, and the memory of hearing is more sensitive and lasting. [11] The sounds in the interactive picture book have two main functions, the first is the narrative function, which is composed of direct narrative and subconscious narrative. The former generally describes the content of the story through dialogue or narration; the latter, as a narration or background sound, potentially serves picture books. The second is the grammatical function, that is, the tone and narrative style should remain unchanged during the page switching process as the elements of content cohesion. [12] However, as far as the current printed picture books of T'ien-kung K'ai-wu are concerned, the auditory feature is mainly reflected in the sound generated in the process of turning over the paper books. This feature is often related to the paper of the book itself, except for the strength of manual turning.

The tactile sense is an important channel for lower grade students to contact, understand and perceive the external environment during their growth. The design of the appearance, decoration, material or surface details of the printed picture book can not only exercise the flexibility of the fingers of the junior students, but also deepen their perception of the material and texture, resulting in a strong desire to touch in the reading process. [11] The paper used for book covers is mostly different from that used for internal printing pages. The covers are usually glossy or matte coated paper with a certain hardness, and the internal printing pages are usually offset paper with good coloring capacity. For electronic picture books, touch mainly refers to the behavior of changing and interacting with the characters in the picture books through touching, clicking electronic products with fingers and other interactive behaviors, and then becoming the interaction subject. [13]

### **3.2. An analysis of the pain of the printed picture book of T'ien-kung K'ai-wu for lower grade students**

Based on the above market survey on the printed picture book of T'ien-kung K'ai-wu and the characteristics of the multi-modal theory in the picture books, this study will use the method of questionnaire survey to distribute the questionnaires related to the printed picture books of T'ien-kung K'ai-wu to the lower grade students through wjx.cn online. In consideration of the understanding capacity of lower grade students, this questionnaire will be passed on by parents and completed by children. A total of 124 valid questionnaires were collected from December

29, 2021 to January 21, 2022. Based on the data obtained through the questionnaire survey, the author hopes to get the pain points and relevant suggestions provided by the research subjects for the printed picture books of T'ien-kung K'ai-wu, and then provide strategies for the development of digital picture books of T'ien-kung K'ai-wu. The following part shows the statistics of some questions in the questionnaire:

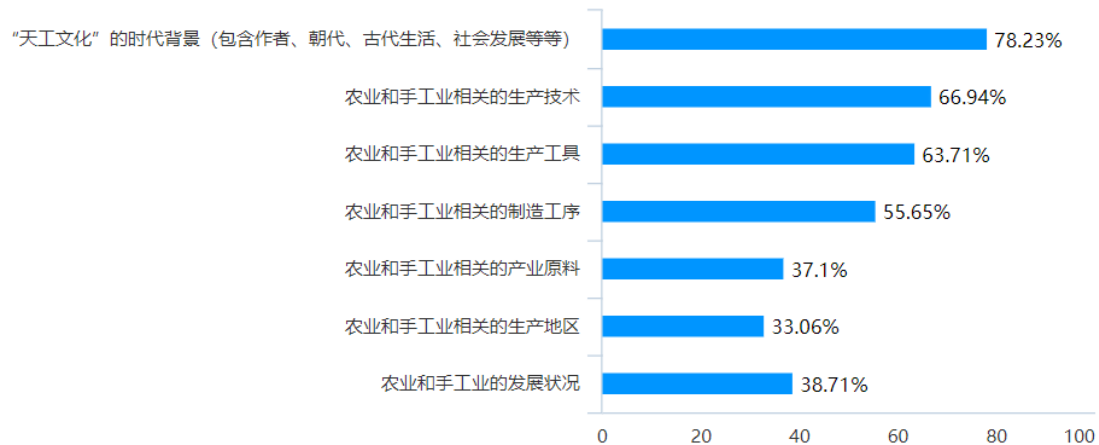


**Figure 1:** Lower grade students' understanding of the T'ien-kung culture

**Figure 2:** The situation of lower grade students reading printed picture books of T'ien-kung K'ai-wu

**Figure 3:** Lower grade students' contact with digital picture books

Figures 1, 2 and 3 show that 51.61% of the people do not know about the T'ien-kung culture, 58.87% have never read the printed picture books of T'ien-kung K'ai-wu, and only 17.74% have experienced electronic picture books. The data shows that the transmission rate and popularity of the T'ien-kung culture among lower grade students are low. This also indirectly reflects the necessity of developing the design strategy of the digital picture books of T'ien-kung K'ai-wu.



**Figure 4:** The extents of lower grade students' interest in different contents of the T'ien-kung culture

As shown in Figure 4, lower grade students are generally more interested in the author of T'ien-kung K'ai-wu and his background, as well as production technologies and tools related to agriculture and handicrafts.

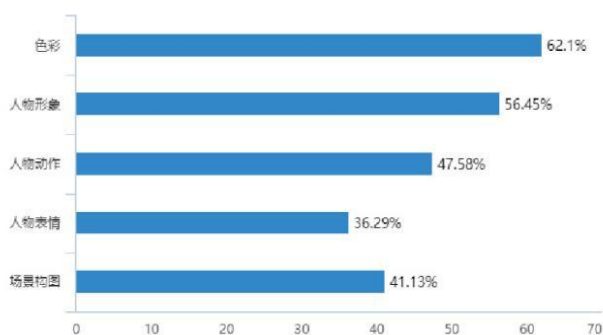


Figure 5: Reasons that make the pictures in picture books not vivid enough

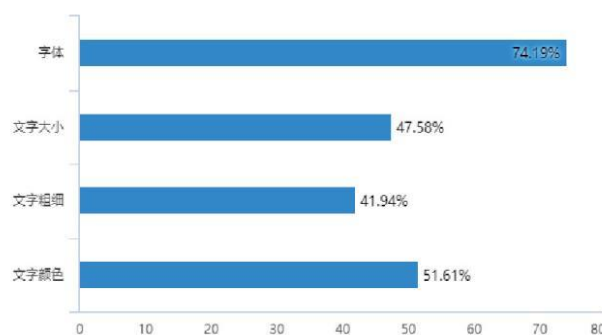


Figure 6: Reasons that make the fonts not beautiful

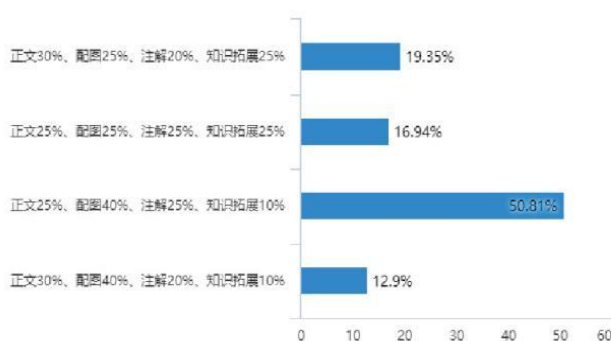


Figure 7: Most suitable proportions of pictures and texts

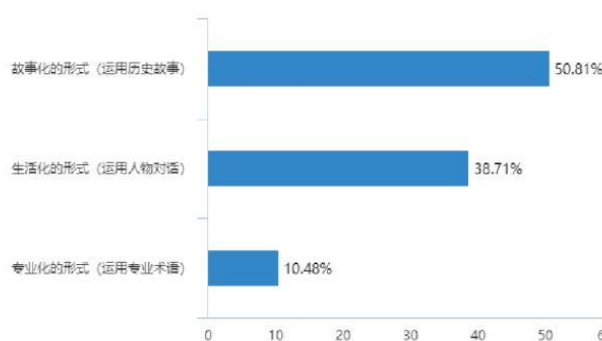


Figure 8: The narrative ways that best help lower grade students accept content

Figures 2-5 to 2-8 respectively show the three elements of pictures, font and layout design, as well as the ways of content expression of picture books suitable for lower grade students. It can be seen from the above figures that the lower grade students think that colors and character images are directly related to the vividness of the pictures; the font types are the most important factor determining whether fonts are beautiful; 50.81% of the people think that the most suitable proportions for the paper picture book of T'ien-kung K'ai-wu are: 25% for the text, 40% for the pictures, 25% for the notes, and 10% for extended knowledge; the expression form of historical stories is considered the most suitable way to convey the content to the lower grade students.

#### 4. The design strategy of digital picture books of T'ien-kung K'ai-wu for lower grade students based on the multi-modal theory

##### 4.1. Visually, attention needs to be paid to pictures, texts and the layout proportions of pictures and texts

##### 4.1.1. Increasing the proportion of pictures in picture books

Considering that students aged 6-8 can't concentrate for a long time, only by grasping their eyes with a large number of pictures in a short time can they better stimulate their interest in reading. According to the above findings of the questionnaire survey, when pictures account for 40% of a picture book, it can highlight the pictures and weaken the texts. When the proportion of the text to the annotations reaches 1:1 (25%: 25%), it can ensure that students can fully understand the text according to the annotations when reading the text. The remaining 10% is used for knowledge expansion. The combination of interactive games or small real-life practice classes with picture books can stimulate children's memory and consolidate their knowledge.

#### **4.1.2. Using bright colors**

If pictures are the first element to attract the eyes of lower grade students, colors are an important factor to form good pictures. Colors can not only set off atmosphere and express emotions, but also construct visual center through brightness and purity. As far as the digital picture books of T'ien-kung K'ai-wu is concerned, in order to alleviate the visual fatigue caused by reading electronic books for a long time, the large background colors of the picture book should be colors with low purity and high brightness. At the same time, the color temperature should be warm, such as light goose yellow, so as to create a warm overall atmosphere for the pictures. As for the elements in the figure, such as natural landscape, production tools, labor figures, etc., the inherent colors in the nature can be used and matched. When the corresponding elements are mentioned in the text, the purity of the color system of the text and its corresponding elements can be raised, thus achieving a highlighting effect.

#### **4.1.3. Cartoon images for figures**

Figures are the central element in pictures. Whether it is to describe the labor scene or introduce the use of tools, figures need to appear in pictures. Therefore, in order to cater to the visual aesthetic taste of lower grade students, the figures should be cartoon or personified, with lovely, witty and evocative temperaments, and the overall images should be rounded.

#### **4.1.4. Round fonts**

From the findings of the questionnaire survey, it can be seen that the font types are a direct factor affecting whether texts are beautiful. As a content carrier, fonts do not account for a large proportion in picture books, but they have an impact on reading comfort. For picture books designed for junior students, the font type should be visually more beautiful on the premise of convenient reading. The font can be more rounded and plump appropriately, which is consistent with the overall picture style of picture books.

### **4.2. From the perspective of hearing, content of the picture books can be introduced through audio stories**

Due to the limited cognitive level of the junior students, they are unable to understand the content of the original work T'ien-kung K'ai-wu for the time being. Therefore, digital picture books will introduce T'ien-kung culture in the form of stories. Designers can set a main character for the picture book, and this character will serve as a guide and assistant of the readers. This assistant will appear whenever the readers begin with a new chapter, and will convey the story to the readers in the form of voice story telling. In the selection of dubbing timbre, flexible and lively voice should be selected, so as to unify with the picture style presented by the picture book as a whole. According to the image of the characters in the picture, we should choose a voice that conforms to the characteristics of the characters, and pay attention to the expression of the characters' emotions when expressing, so that we can further shape the characters. At the same time, due to the limited understanding ability of the junior students, the overall speech speed should not be too fast in the dubbing of picture books. The rhythm should be stable and even, and attention should be paid to sentence breaking, so as to divide the level of the manuscript and make them more vivid. Soft or cheerful background music can be appropriately added to the knowledge expansion parts and other parts without written content so as to set off the atmosphere. When readers complete some reading tasks, they can play encouraging voice and passionate background sound to bring different hearing experiences to each part of the picture book.

### **4.3. The tactile sense is reflected in the touching, clicking and interaction with the electronic screen**

Tactile interaction and behavioral feedback are two important parts of tactile experience. Tactile interaction refers to the reader's interaction functions such as voice playing and book

flipping through clicking, dragging, sliding the electronic screen and other actions. Behavioral feedback refers to that the electronic screen, after receiving the reader's action, informs the reader of the current status of the system through pop ups or sounds. The introduction of interaction design in tactile experience can enable junior students to connect with the storyline of picture books, thus obtaining a sense of participation. When reading the picture book, the reader can use the zoom action of his fingers to zoom in or out of the picture book according to the reading needs. This function is impossible for printed picture books. The zooming function can avoid eye pressure caused by too small font size, which is inconvenient to read, to some extent. Two hidden icons are set at the left and right ends of the electronic reading screen. When the reader taps the screen, the hidden icons will be displayed. Readers can click the icon as needed to turn pages left and right. The left icon allows readers to turn pages forward, and the right icon allows them to turn pages backward. This saves more time and effort than paper picture books. At the same time, buttons for adjusting screen brightness and volume are hidden on the left and right sides of the screen. They have followed the adjustment features of many video players, which can reduce the learning cost and adaptation time, and make it easier for readers to adjust parameters according to ambient light and ambient sound during reading. The left and right sides allow readers to adjust by sliding their fingers up and down. The left side adjusts the brightness and the right side adjusts the volume. Considering that readers may accidentally touch the screen during reading, causing unnecessary changes, they can achieve screen lock by simple double clicking operation. The locked screen will not change due to tactile behavior. To operate the screen, the reader can unlock it by double clicking the screen. The tactile interaction of electronic picture books breaks the traditional tactile experience that paper picture books can only transfer through books and paper materials, and provides more tactile interaction methods, which is an innovation in the tactile behavior of the printed picture books of T'ien-kung K'ai-wu.

## 5. Conclusion

As an encyclopedia of agriculture and handicrafts in ancient China, T'ien-kung K'ai-wu is of great historical value and inheritance significance. The design strategy of the digital picture book of T'ien-kung K'ai-wu proposed in this study can contribute to the theoretical basis for the development of digital picture books. At the same time, it can bring immersion experience of T'ien-kung K'ai-wu to lower grade students from the perspective of multiple senses, so that the T'ien-kung culture can be better inherited, educated and developed.

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