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## WD5.1.3b Story Illustrations: State of the Art and Design Principles for TERENCE

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Abstract
This document reports about the state of the art of illustrations styles and interaction paradigms used in applications and games relevant for the illustration and game visual and interaction design tasks for TERENCE.

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# Table of contents

1	Introduction.....	5
1.1	Task and Document Description.....	5
2	Dimensions of Illustration Design.....	7
2.1	On the Role of Illustrations.....	7
2.1.1	The dual core theory - illustrations and inference.....	7
2.1.2	Information delivery in text and illustration.....	9
2.1.3	Role of illustrations for poor comprehenders and deaf.....	10
3	Visual Characteristics of Illustrations.....	12
3.1	Composition.....	12
3.2	Rendering style.....	13
4	The Principles for the Design of Story Illustrations in TERENCE.....	15
5	References.....	17
	Appendix - Figures.....	19

## 1

TERENCE

# 1. Introduction

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The major contribution of WP5 to the TERENCE system involves the illustrations for each page of the 32 stories, written for the 2 age groups, and the design of visual content – small images depicting the question and choices for answers – for the Smart Games. As the latter was based on visual material produced for the stories, and the design was restricted to small framed images, the major design issues were about the illustration of the stories: arrangement, composition, palette, style.

The progress (reported on in WD5.1.1 and WD5.1.2) and final result (reported in WD5.1.3 online repository) can be seen.

For D.5.3 it was also required, that the deliverable will contain : “... a short technical report on the state of the art and design of illustrations for the TERENCE learners according to the requirements of D2.1.3”

In this document we sum up the result of our research, partly done before starting to illustrate, and partly parallel to producing the material for the first demo version at the end of year 1, partly done in the past months based on recent interactive books. The latter is also relevant as in the past 3 years there have been a huge progress in illustrated interactive books for kids. WP5 pursued a research on the representational principles and composition and visual styles and in traditional and interactive story books designed for 7-11 year old kids.

Another motivation is that a survey of the role and styles of illustrations in stories in itself is a valuable and stand-alone document, and is of interest for the ICT community, independent of the actual content designed for the TERENCE system. Namely, the visual content in ICT applications, especially for kids, is getting an increasing role and attention. It rarely happens what happened in the TERENCE project, namely that the design of the visual content is given to experts, or even, artists. We strongly believe that the ICT community, in order to develop really inviting applications for kids, must exploit the huge heritage and versatile possibilities of (story-book) illustrations.

## 1.1 Task and Document Description

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In surveying the illustrations used in interactive books and applications for 7-11 year old kids, we can separate two major issues, each with own space and dimensions of design:

- 1. Function, composition and style of (static) illustrations:** In (traditional, static) story books for children, information is duplicated and/or distributed in the text and the illustration. It is far from evident how to visualize the “factual” part of the story: repeating or extending what is written in a convergent or divergent way, depicting a complete or partial world? Some illustrations may be without explicit pictorial semantics, but add to or enhance the emotional sphere. What visual styles can be

identified, and “honored” on professional forums? How illustration and text may be placed?

- 2. Dynamism of illustrations:** In an interactive book designed for present-day digital devices, the illustrations can “come to life”. What dynamical phenomena can be identified in illustrations? What is the added value of the moving capability of the images? How is it evoked? How do the time-related changes in the image and the (read or told) narrative correlate? What is the (assumed) strategy of reading and interaction? Which of the technical possibilities of the interactive device are used to interact with images? How does the reader “learn” about the interactive possibilities in an image? What is the role of sound in the interactive images?

At the early stage of the TERENCE project it was decided that the story illustrations will be entirely static, in order not to distract kids from the reading task. Hence in this survey we will not address the design issues of interactivity.

The fact that the TERENCE illustrations were not to be animated, made it possible to consider, in principle, the entire scope of expressivity of static book illustrations, both designed for printed and the digital distribution. (Often today, well established story books are adapted for digital media, re-using the original drawings.) At the final choice of style and execution of the illustrations the (capacity) constraints of the digital medium and the variety in the screen sizes were taken into account, as well as other conditions of the production process.

We, according to the competences in WP5, focus our presentation on the visual design in children book illustration, based on examples and practices from renowned illustrations, such as award-winning ones from leading international forums [1, 2, 3] and some apps. We do refer to literature we found on the role of illustrations, and particularly for our target group.

The document is structured as follow. Section 2 is devoted to the role of illustrations. We start with giving a foundation, in general, and then look at literature relevant for our target group. Then we give illustrative examples of role (and style) of illustrations using a single story as common narrative reference. Then in Section 3 we give a representative panorama of the visual aspects of illustrations for digital content for the 7-11 age group. In Section 4 we sum up the specifics side-conditions given by the requirements of TERENCE, and the design principles used by WP5 to create the story illustrations. We note already here that these design guidelines serve as general ones for the age group, and should be complemented with the specific needs of the sub-group in the target group concerning available information channels (hearing – deaf) and cultural differences( Italian – British).

## 2 Dimensions of Illustration Design

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### 2.1 On the Role of Illustrations

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In general, as the proverb says, an image is worth of 1000 words. It is interesting to think about the role of images in educational material (particularly, for reading) for young children. It is a common phenomenon that kids (and parents too) look at the pictures when choosing a book, which also indicates the value of the illustrations. On the highest level, as also argued by Fans (1996) [5], the following roles of images can be distinguished:

1. **Engagement, motivation:** the images make and keep the child interested in reading and using the learning environment.
2. **Aesthetic taste improvement:** illustrations broaden the visual language of the child, they improve their aesthetics (if the illustration is done in an artistic way).
3. **Visual language development:** illustrations per se make the child learn to read visual language (e.g. interpret perspective and shadows in images).
4. **Mental development:** illustrations – especially artistic ones – contribute to the development of fantasy of the child.
5. **Information delivery:** the illustrations may help to understand the story or its elements, by providing redundant or complementary information in a visual language. An illustration may cast light on natural or cultural phenomena in an indirect way, providing background information not delivered in the text in detail, or not at all. For example, a textual fact as “it was winter”, if illustrated by the scene of a snowy village, tells about what winter is like, of course on the geographical location of the story. This may be new for children who have never experienced a snowy winter. For the implicit information, the cultural specifics of the village are a good example – an Italian village is different than a village in UK. By choosing one or the other, the child learns about cultures and geographical locations.
6. **Focus of attention:** the illustration may focus the reader’s attention to certain character or aspect of the story, by a selective rendering, or by using mechanisms to visually emphasize certain elements (e.g. by perspective, by highlight). The illustration may enhance the emotional content.

While the first 3 roles are usually agreed upon, and are not strictly related to the goals of TERENCE, 4-6 are of specific relevance. If we look at the literature, we find some interesting results of work investigating these aspects.

#### 2.1.1 The dual core theory – illustrations and inference

The dual-code theory/repetition hypothesis proposes that information that is presented twice will enhance comprehension and memory, as argued by Gyselinck and Tardieu (1999) [6] and Glenberg (1992) [7].

Schnotz and Bannert (2003) [14] investigated the role of multiple representation in learning among university students. The findings indicate that the structure of graphics affects the structure of the mental model. Whereas task-appropriate graphics may support learning, task-inappropriate graphics may interfere with mental model construction. Thus, presenting graphics is not always beneficial for the acquisition of knowledge; the content and form of graphical presentation is of relevance for the contribution to the learning process.

Rasch and Schnotz (2009) [12] conducted a study on the effects of interactive and non-interactive pictures in multimedia learning environments. The target group was university students. The outcome of the study again draws attention to the role of subtle design decisions. The authors found that adding pictures to text was neither beneficial nor harmful for learning. In terms of learning efficiency, however, learning from text only was more successful than learning from text and pictures. Interactivity was beneficial for certain learning tasks, but not for all. The visualization format affected participants' interaction with pictures, but not the learning outcomes; however this effect was not influenced by interactivity.

Pike and Barnes (2010) [11] conducted an empirical test to study the effects of illustrations on bridging inferences for 7- to 11-year-olds. They used illustrations geared towards the inference task, and illustrations which emphasized other aspects of the text, thus ones not relevant to draw the inference. In addition, they used text-only version too. Illustrations both facilitated and interfered with inference, depending on the content of information depicted; however, this effect was reduced as grade increased. This study makes us aware of the possibility that illustrations, if not showing relevant aspects, may decrease the inferential performance. Also, as the authors pointed out, several other factors may have an influence on the contribution of the pictures, namely:

- time and attention children of different ages and skills devote at the pictures;
- when the picture is presented with respect to the text;
- the amount of time children take to read the text may differ depending on whether there is a picture present or the characteristics of the picture,
- effect of illustrations on inferential comprehension that may differ for good vs. poor word decoders and for good vs. poor comprehenders.

In an exploratory empirical study by Ruttkay, Béneyei and Sárközi (2013) [13] the authors compared text recall and comprehension of 8 year old children (all normal hearing Hungarian kids). Subjects were using exactly the same textual and visual material, in one group (P) as a printed traditional book with illustrations, and in another group (T) as an interactive book on tablet, where the illustrations could be animated by touch gestures. The two groups were



counterbalanced for reading skills, gender and media usage. Though in TERENCE no interactive possibilities were used, we find it relevant to quote this study, as it gives a perspective to the arguments for using static visuals in TERENCE. Nevertheless, we are aware of the necessity of a scientific evaluation of the perils and promises of the dynamic illustrations. In our impression, this type of the work is in its infancy, partly because of the intrinsic difficulty of pursuing tests with subtle variants of dynamic illustrations on all levels, from gaze attention via cognitive load to long-term memory effects. Here are the major observations:

- all kids expressed their liking of and preference for the interactive book;
- the interactive possibilities did not distract kids from reading the text; and the new medium motivated those who did not like to read a traditional book;
- in the improvement in recall of the narrative of the story and expressivity of the language there seemed to be a better performance in the T group.

## 2.1.2 Information delivery in text and illustration

Corrigan and Surber (2009) [4] the authors found that illustrations do account for a big part for information delivery in children books, and are not separable from the less cohesive texts. "Pictures play an important role in filling cohesion gaps in the text. To some extent, pictures can be rendered as text and increase cohesiveness indexes and comprehensibility."

According to Fang (1996) [5], pictures lure children to read and interact with the text and provide mental images, allowing them to understand the written text more easily and remember it longer. Illustrations may also increase the comprehension and retention of the text material, as shown by Hoffman and Schallert (2004) [8], and earlier by Read and Barnsley (1977) [10].

However, when taking a closer look at what is told in a (literary) text and shown in the accompanying picture, one can distinguish the following paradigms, according to Varga (2012) [15]:

1. **Duplicative images** remain close to what is "told" in the text, and do not specify or extend it, but "map" it to a visual language.
2. **Enhancing images** add substantially to what is told in the story. This may involve choosing some specific reference (e.g. cultural or historical) through all the illustrations, or adding details to scenes or visually explaining, or even extending the narrative of the story with depicting in the text unmentioned events.
3. **Atmospheric illustrations** do not depict the narrative or the characters and the location as told in the text, but function as artistic expression where form and color are

used not to provide realistic visual representation of objects or events, but of emotion and sphere or symbolic expression of the nature and essence of the story.

Duplicative images have a role in the first (language) books for children of 3-6, where there is no narrative, but the learning of concepts or letters or words. For illustrations accompanying real stories, full mapping is impossible, because of two reasons:

- often much more is told in the text than can be rendered in a single image,
- characters, objects and events appear in a complex, but usually in the text not (fully) explained context, leaving a lot of details to be fill by the reader's imagination – hence the text tells less than any concrete visual presentation based on it.

However, there is always some mapping of story elements. This mapping may be *convergent* with the text, or *divergent*. The divergence may be on the level of facts (the illustration contradicts to what is told in the text) or on the level of interpretation (e.g. the visual representation of a personage suggests different role or personality than in the story). It seems to be natural that divergence should be avoided, as it induces contradictory, conflicting "messages". Children seem to critically recognize factual divergence, let it be deviation from what is "told" in the text or of their own, existing mental images of concepts, but are prone to interpretation divergence. The interpretational divergence is a subtle issue, as it assumes a – by the author of the story intended – interpretation of the story, its characters by the reader.

For the story-reading age group of TERENCE, the enhancement is the common role of the illustration, in accordance with the study by Glanberg (1992) [7]. This underlines the importance of the illustrations and the consequences of the (conscious or unconscious) design decisions of the illustrator.

### 2.1.3 Role of illustrations for poor comprehenders and deaf

It is natural to assume that our target group – poor comprehenders and deaf children – differ in their mental processing of text than good comprehenders. Hence, the role of illustrations may be different in their case. Yuill and Joscelyne [16] compared the effect on story understanding of organizational cues and strategies on good and poor comprehenders of age 7-8. They found that providing integrative cues improved comprehension by poor, but not good comprehenders, but had no effect on verbatim recall. Both skill groups recalled more main ideas when the story was accompanied by pictures. Results show less skilled comprehenders to be generally more dependent on supportive context than skilled comprehenders, but they can learn to use cues to improve their comprehension to the level of skilled comprehenders.

Marshall, Gentry., Chinn and Moulton (2005) [9] investigated the added value of picture and sign language to text, looking at the text comprehension of deaf university students. The They

found that story presentation by print only was the least conducive to story comprehension, while stories presented via print and pictures were most readily understood. Interestingly, the level of comprehension was marginally higher for stories presented by print and pictures than for stories presented through print, pictures, and sign language.



## 3 Visual Characteristics of Illustrations

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### 3.1 Composition

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In traditional books, also due to the technical limitations, illustrations are in a separate, own frame, often on a separate page. However, with the advent of digital printing technology, we see a variety of playful arrangements emerging. Thus for the *placement of illustration with respect to the text* the following alternatives exist:

1. **Separated, in frame:** The illustration has its own rectangular space (albeit not fully filled), the text is either below-above, or on a different page, see figure 1 and figure 5.
2. **Embedded in text:** The illustration appears “within” the text body, as smaller image.
3. **Illustration and text body in unifying composition:** The illustration and the text form a visual unit, the form and size of the illustration influences the placement and alignment of the text. However, this does not hinder reading, as long as the text is clearly visible, see figure 2. A bad, but regrettably common solution of using transparent text box at the bottom is shown in figure 4 .
4. **Illustration and text integrated:** The text, or a portion of it, is part of the illustration. This happens when the text is short (e.g. titles, short verse), or involves dialogues, or is of educative purposes, e.g. to teach spelling of objects, see figure 3.

As of content shown in the illustration, the major differentiating principle is if:

1. the illustration depicts a complete scene, see figure 4, and 9;
2. it focuses on some major characters or events, see figure 6 and 11;
3. provides cognitive and/or emotional reference by showing particular aspect of the story (objects, weather, ...), see figure 7.

As of special composition, the following practices are used:

1. **three dimensional** (3d) arrangement and illusion (perspective, shadows), usually coupled with realism, see figure 9;
2. **two dimensional** (2d) visualization, either in a scenic (see figure 2) or in a dismantled (see figure 6) arrangement of the elements, usually with less detailed and somewhat abstract forms. An interesting option is the layered 2.5d effect, see figure 8 and 10.

Here we note that looking at children books for our age group (we did it in UK and Hungarian bookshops), the majority of the illustrations use 2d arrangement and a non-realistic depiction. Within this category, however, one can see a huge plethora of artistic styles (see next section).

## 3.2 Rendering style

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The first issue is the **level of realism** shown in the illustrations. The preference for close-to-realistic rendering can be witnessed mostly in books where the story takes place in a “realistic” environment, and the (fictional) story is close in time and space to the reader. Another motivation for realism is when the reading material has an educational purpose, that is, the illustration has a strong information delivery function e.g. to illuminate new concepts, or scenes.

As of choice and usage of colors, the major categories we can observe:

1. Monochrome: black and white, see figure 11; or a scale of a single color, see figure 12.
2. Usage of a few, often primary colors (2-4), see figure 3.
3. Usage of a rich color palette, see figure 9 and 10.

As of appearance of colors, several factors – related to the technique used to produce the illustration – play a role.

1. **Brightness:** For younger age bright colors are used, especially for educative purposes, and to attract the child's visual attention, see figure 1, 9 and 10. For older age, and in books meant for girls, or about sad content, opaque and pastel colors can be seen, as in figure 5 and 8.
2. **Clarity:** The most common practice is to use uni-color, fully covering paint. However, one can also come across vague contours made with aquarelle or chalk, and non-homogeneous surfaces resulting from paint, see figure 5 and 10. These, more artistic rendering styles serve the functions 1-4 discussed in Section 2.2.

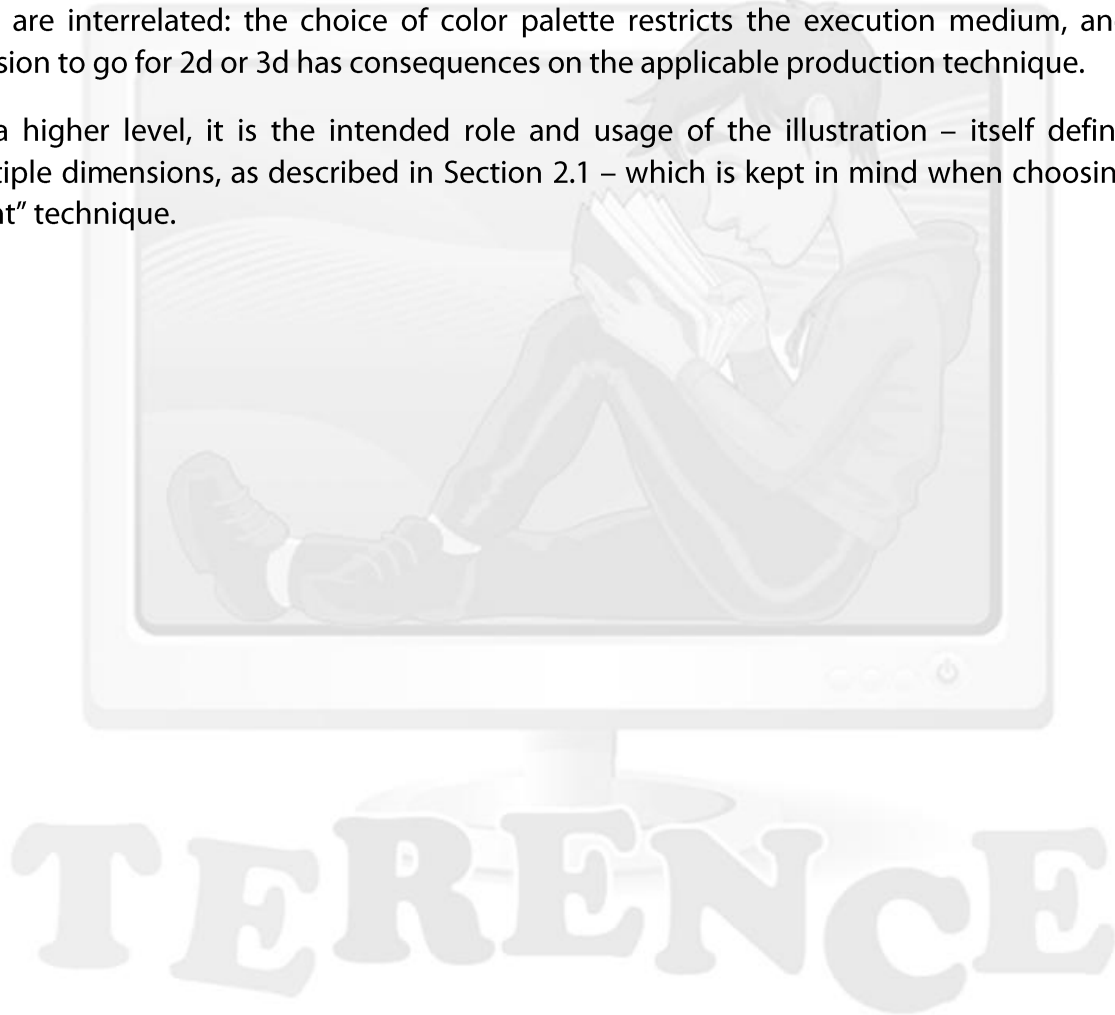
As of the medium used to produce the illustrations, we see a rich arsenal of tools and techniques (some made also possible to be imitated by digital tools):

1. **Pencil, chalk, felt:** the illustrations are fresh, as if made on spot, sometimes in the style close to that of children drawings or artistic renderings, see figure 2, 3 and 6.
2. **Print and etch:** this gives a somewhat ancient look to the illustration, which matches well historic topics, or to indicate a “time shift” within the illustration, see figure 5.
3. **Paper cut:** this gives silhouette-like forms, making a kind of puzzle to decode the illustration itself. Suits well with fictional or culturally far-away stories, see figure 11.
4. **Aquarelle and color ink:** the unpredictable flow of the paint and ink, and the thin cover creates a poetic atmosphere, stimulating fantasy, see figure 8 and 10.
5. **Acryl and oil paint:** these paints cover well bigger surfaces, thus suitable to create cheerful and colorful scenes.

Last but not least remains the question of **free handed versus vector-based production** issue. It is very tempting and common to use vector graphics (see figure 1, 4 and 12), because of technical considerations: easy and fast to create and alter, the forms can be scaled without loss of detail and such images yield small-size files. The latter two are important advantages for illustrations to be used on different screen sizes and resolutions. So no wonder that vector graphics has become the ruling style. On the other hand, the vector-graphic illustrations give a common, somewhat synthetic and simplified impression, as opposed to hand-made illustrations with the details, irregularities and personal touch of the artist.

Finally we note that the above dimensions are not used independently. On the one hand, they are interrelated: the choice of color palette restricts the execution medium, and the decision to go for 2d or 3d has consequences on the applicable production technique.

On a higher level, it is the intended role and usage of the illustration – itself defined in multiple dimensions, as described in Section 2.1 – which is kept in mind when choosing the “right” technique.



## 4 The Principles for the Design of Story Illustrations in TERENCE

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The illustration of the TERENCE stories was an extra challenge for the illustrator, as – as described in D1.2.1-3 – the illustrations were not meant to deliver information which was the subject of learning (from text), and was later to be tested. The illustrations had to be made before the exact details of “what not to reveal” was specified (to be generated on the bases of the annotation of the stories). Hence the information delivery had to be restricted to the scene and the sphere. The focus of attention role was not needed for the story illustrations, but were primarily with the smart game illustrations. From the remaining functions discussed in 2.1, the motivation and engagement was the most important. There were two additional constraints: the two age-groups 7-9 and 9-11, and – from Release 2 - the fixed size and shape of the placeholder for the illustrations.

Taking into consideration all these constraints, the following design principles were used for creating the TERENCE story illustrations (for samples, see figure 13 and 14):

- **content:** should not reveal “facts” about what is told on the page. The majority of the illustrations depict scenes from such a view that important actions are not shown. For a small proportion, where the text did not involve (new) scenes or little happened, the sphere was given by some reference illustration.
- **placement and composition:** Only one size of rectangle in 2 stands (horizontal-vertical) was to be used for illustrations according to the specifications for Release 2. In order to serve motivation better and allow a bit more compositional freedom, two design principles were used by the illustrators:
  - The “background color” of each drawing was used as background for the entire page, in this way suggesting some unity with text and illustration, but keeping the fix place for texts. The background colors were chosen in such a way, that the text (in white or black) could be well read.
  - The standing illustrations could be placed to the right or to the left of the text. Hence there was some freedom still for composition, e.g. characters could be placed looking “towards” the text.
- **style and rendering:** as no details were to be shown, a somewhat abstract 2d rendering style was chosen. In a 3d realistic rendering lack of (narrative) detail would have been odd and disturbing. Moreover, for the age group 7-9 a 2d color-coded style is the one used the most in illustrations, and appreciated by kids. As the visual style of TERENCE was to be kept uniform, we used the same rendering principle for the older

age group too. However, for those stores somewhat more details were added, wherever the text made it possible.

- **Color:** As illustrations were not meant to attract the reader too much, a pastel palette was used wherever it was appropriate with the content of the story. In the color choice too, a distinction was made for the maps, which are in more bold and bright colors, as if inviting the child for a journey. This was in line with the fact that maps are shown on their own, while illustrations appear next to text to be read.
- **hand-made versus vector-based:** the illustrations of the stories were all vector-based. This was decided on the basis of the usage and production constraints: the size of the illustration placeholders changed substantially from Release 1 to Release 2, and the envisioned usage on different screen and tablet sizes, as well as the need for re-use elements in visual material for smart games made it also evident that the scalable vector-based forms are the appropriate. However, the maps, which are of a different entity and were not to be re-scaled, were produced by hand, painted with acrylic on paper. These hand-painted maps were to add a visual counter-balance to the style of the story illustrations. This choice could be justified on a mental level too, as maps are often associated with hand-drawn, irregular images.
- **aesthetics:** in course of TERENCE there has been discussions about what is the “best to be used” style. On the one hand, in order to engage and motivate the kids, one cannot discard of their visual preferences, as influenced by mass media products (such as computer games, or Disney films). On the other hand, the participation of artists in an ICT project made it possible to realize more individual, playful and by all means aesthetically challenging visualizations, within the set usability objectives and constraints. The illustrators in WP5 found it important that TERENCE, albeit in an indirect way, also should improve the aesthetic taste and the visual language of the children. In the development course, the drawing style was tested with the age group on a small scale and the feedback was encouraging.
- **usage context:** the original design envisioned tablet usage. However, in course of the TERENCE project a broader set of devices, including PCs, was considered. The vector-based illustrations do support a broad range of displays.
- **different illustrations to be offered from time to time:** the digital medium would allow to show more or less different illustrations from time to time. In our view, this would increase the engagement of the child to return to the same story. Also, on a longer run, the difference in illustrations may be based on the cognitive skills of the child and the state of progress with the comprehension. This feature is beyond the capacity for developing TERENCE, but would be an interesting path to explore.



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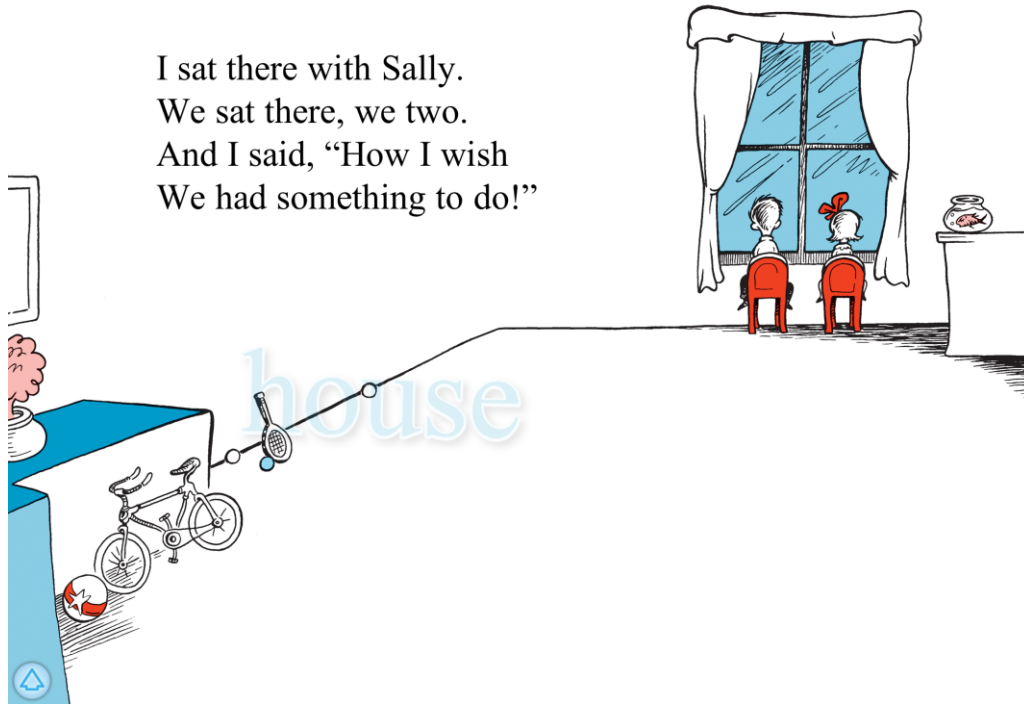
# 6 Appendix - Figures



1. figure The Tree Little Pigs by Chocollapps.



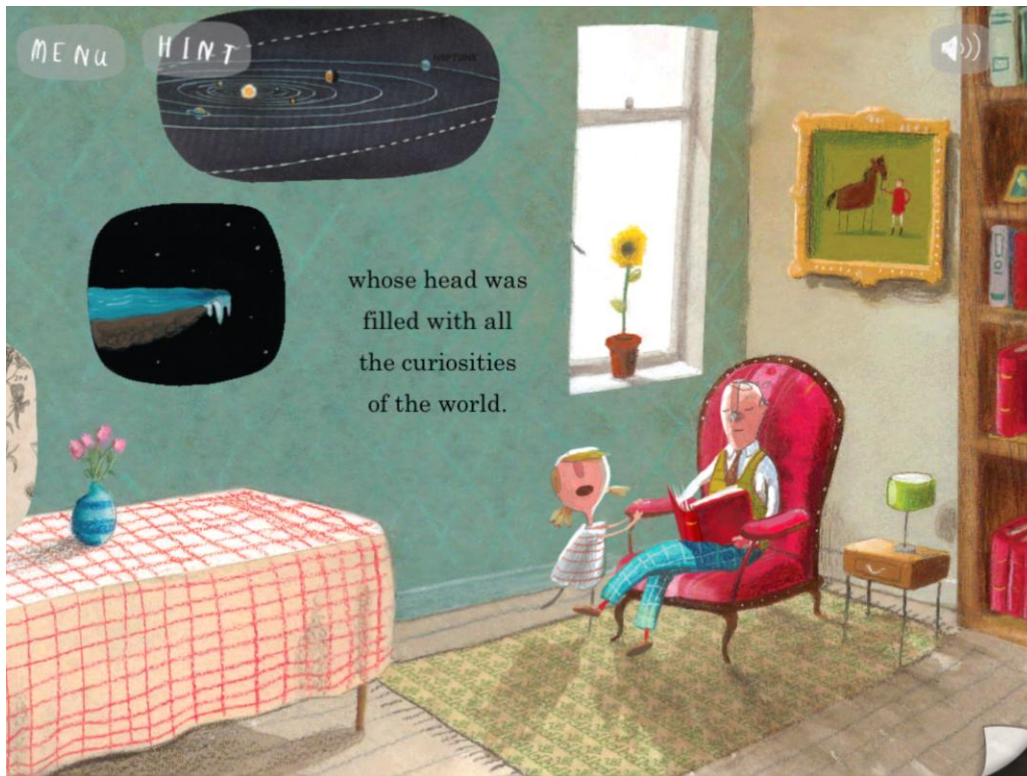
2. figure Blame it on the Yeti by Nokedli.



3. figure The Cat in the Hat by Oceanhouse.



4. figure Lulu in the Amazon by Zanzibook.



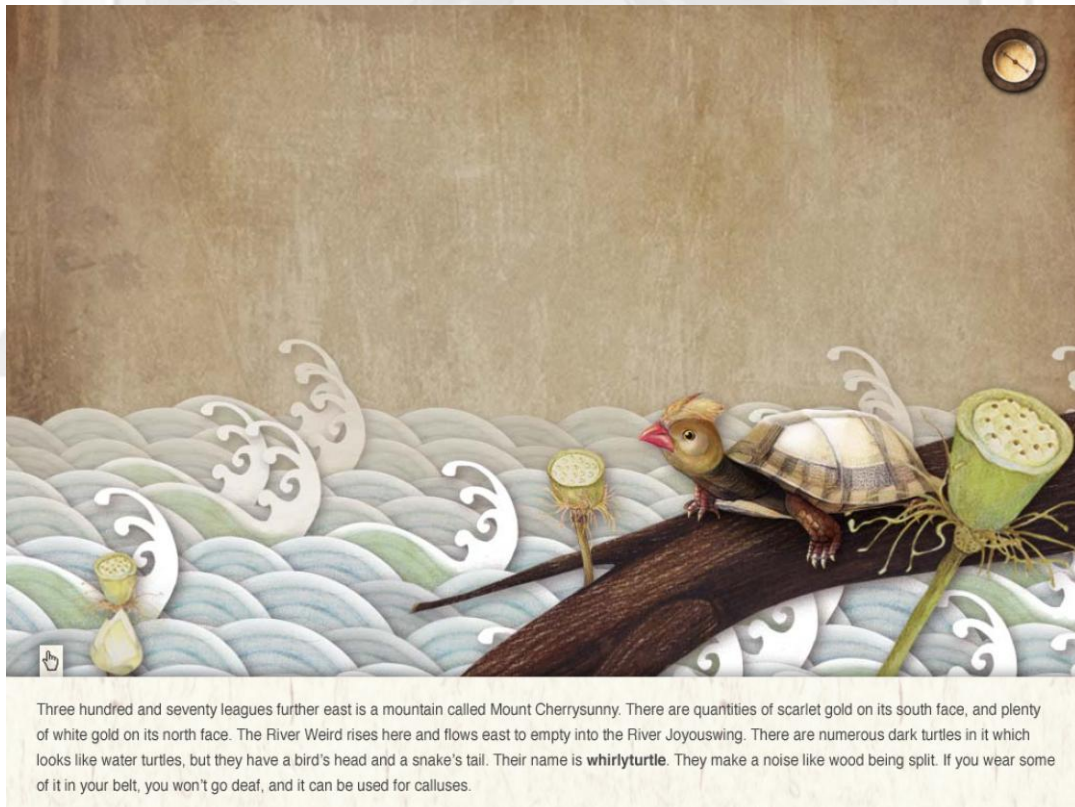
5. figure The Heart and the Bottle by bold creative.



6. figure The Heart and the Bottle by bold creative.



7. figure The Heart and the Bottle by bold creative.



8. figure Shan Hai Jing by



9. figure Nighty Night by Fox Sheep.



10. figure Tim Tom by Iboo Interactive.



11. figure Cinderella by FairyTale Onlus.

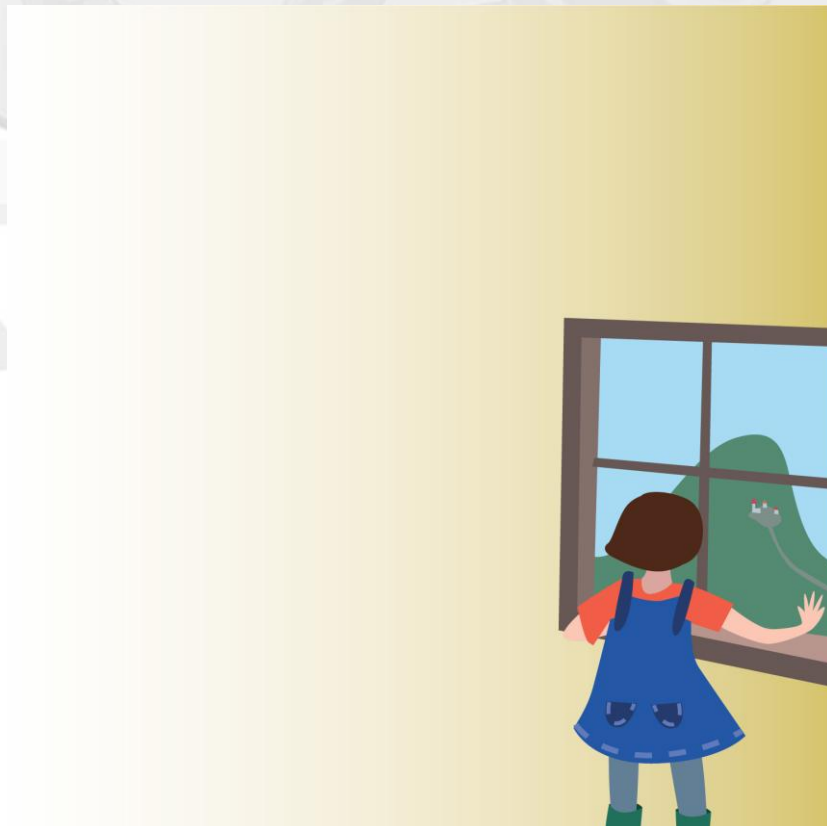


12. figure Nedi the Yeti by Irreverent Bits.





13. figure TERENCE story illustration with dark background, text at the top.



14. figure TERENCE story illustration with light background, text at left.