Development of Software that Supports Young Children’s Narrative Productions.

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Abstract: In this study, I created a tablet PC application to support children’s narrative skills, which begins to develop actively around the age of five and a half years. My aim is to stimulate storytelling to increase the event categories of protocol and to support causal relationships among sentences. After reviewing the relevant previous research, I considered the support methods and developed the necessary functions.

To investigate the effectiveness of this software, I conducted an experiment to compare the story protocols of five-year-old children. One group used paper crafts and the other used the software.

The results showed that the proposed system stimulates storytelling and increases the event categories in the protocol of each story. In particular, the causality of a character’s emotional state is improved by using a function to change facial expressions. Children can also use causal relationships and compose stories that are easy to understand.

1. Introduction

All humans are natural storytellers. Narrative production refers to the expression of the imagination by means of language knowledge and on the basis of experience (Vygotsky 2006). Narrative activities are very important for the development of children between 5–6 years of age. This is due to the change that takes place in the developmental stage, namely, the change from playing within one’s own imaginary world to playing with other people and talking to them. Narrative is an essential form of language through which children describe their own experiences and communicate their views of the world. Through their narrative activities, children are not only able to represent their understanding of the world but also to understand it both factually and emotionally and find their place in it (Komatsu 2006).

It is said that the change in the linguistic environment that children experience in the social context of school culture after entering elementary school is rapid, and it is with difficulty that they adapt to this change. Nowadays, the instruction of language before entering elementary school is one of the subjects in which the importance of cooperation between a kindergarten and an elementary school is highlighted. Thus, an environment that encourages narratives while playing is required so that children can express their ideas correctly.

For the above reasons, I have developed a tablet PC application to support children’s narrative skills. In order to facilitate the development of language expression, this software, which examines how narratives are supportable, is proposed. In order to develop this software that promotes the language expression of young children, some points were researched with respect to how a narrative is supportable. Based on previous research, an investigation of the development process of the narratives of young children and an analysis of their understanding of tales, the cognitive functions that support narratives, etc., are conducted. This paper introduces the methods for analyzing children’s narratives as well as the implementation of the software.

2. Background

2.1. Narrative Development

Children’s play patterns change as they get older. Children start out by engaging in a “solo” play style and gradually learn to engage in more social play. At age 2, children's play is solitary. That is, children play alone with toys regardless of their proximity to other children. Children in this stage also speak predominately in the first person during fantasy play. At age 3, children are predominantly focused on “parallel” play. The child plays with similar toys in the same play style as other children. By age 4, children engage in more social play. Their play becomes more "associative" and "cooperative." They are concerned with common activity and able to have...
conversation with a common goal. By age four, children also become increasingly competent at speaking from a perspective that is different from their own. Make-believe play is at its peak when a child is between the age 4 and 7 (Vygotsky, 2006). While preschool children aged between 4 and 7 are able to construct make-believe roles or situations, they are acquiring the ability to present the content of their fantasies to others, through the use of the narrative voice.

Children's narrative skills begin to develop actively at around the age of five and a half years. Narrative production requires certain cognitive functions. Children develop a plan function, monitor function, and evaluation function at around the age of five and half years (Uchida 1996). The contents of utterances also change with age (Akita et al. 1987). Children's understanding is promoted by visual information such as illustrations, and production, by the activity of developing a tale schema (Nakazawa et al. 2005). In particular, clarifying statements expressing the intentions of characters facilitate children’s understanding and promote their narrative productions (Yui 2002).

Vygotsky defined the zone of proximal development as 'the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers' (Vygotsky, 2006). According to this theory, a child performs at a higher developmental level of abstraction and performance with a knowledgeable and skilled partner than she would achieve independently. Adults serve as the competent partner in emergent literacy activities to support children's literacy learning. With parents, teachers, children engage in many different kinds of conversations together exchanging information, disciplining, socialising, showing feelings.

2.2. Related Work

Technologies to support children's storytelling have become increasingly common. For example, previous work at MIT has established the paradigm of the Story Listening System (Cassell, 2001). One of these systems, the StoryMat (Ryokai & Cassell, 1999) recorded children's oral stories and the movements of stuffed animals made on a technologically enhanced play mat. When another child played with a mat, the stories were played back as animations - echoes of the previous playmate. Results demonstrated that interacting with peer stories on StoryMat led children to tell more imaginative and structurally advanced stories. Another SLS, TellTale (Ananny, 2001) invited children to record segments of a story into the body parts of a plastic toy caterpillar. After a short period of play, including deciding how to arrange and segment story sequences, children exhibited more sophisticated use of discourse connectives(e.g. 'and', 'then', 'because') and story event language. Sam was created to give technology a social role in supporting young children's literacy learning (Ryokai, 2003). Sam is projected on a screen behind the castle, and can both listen to a child's stories and tell her own. Sam tells stories using more advanced forms of linguistic expressions (quoted speech, and enough temporal and spatial information for the audience to be able to reconstruct the story). By interacting with a slightly more advanced peer, children model Sam's linguistic behaviour and therefore, perform their storytelling task in a more mature form themselves.

StoryRooms(Guha et al, 2006), a physical storytelling technology is developed at the University of Maryland's Human-Computer Interaction Lab (HCIL). With the use of low-tech and high-tech storytelling elements, children can author physical storytelling experiences to share with other children.

A virtual environment called PUPPET(Marshall et al, 2005) is introduced, which aims to allow children to engage in playful interaction with autonomous agents, while recording dialogue for the characters in the world. By recording aspects of children's activity while they are engaged in improvisational play, virtual environments can provide powerful tools to support children's reflection about aspects of narrative.

Sato (2006) built a system environment that would lead to diversification in human relationships by enabling communications between a child and grandparent via the Internet using a computer. By using this system environment, they can play make-believe roles. A child supported by this system could communicate significantly with adults.

2.3. Design Concept

Based on the previous research discussed above, our software implements a function that automatically displays and operates pictorial information in order to support children's narratives. To increase their contents of utterances, children can operate certain functions, for example, a setup to control expressions that display the intentions and emotions of characters, a setup to control the visual scene, and a setup to control the characters' actions. Furthermore, each tale is divided into three sections—introductory, development, and solution—so that
young children can develop their own conclusions. In the introductory section, an adult introduces the tale to the child so that he/she can understand its theme. In the development and solution sections, the child continues the tale.

Furthermore, the target that a child’s narrative production should achieve by using the function of this software is set as below.

1. When a child develops a tale by setting up the pictorial information by him/herself, the child will be stimulated and his/her narrative production will increase.
2. When a child develops a tale by setting up the facial expressions of characters by him/herself, the protocols on the characters’ emotional states, which are difficult for young children to grasp, are promoted. Further, when a child creates a tale by setting up the visual scene and the actions of the characters by him/herself, the context of utterance will become more varied.
3. When a child creates a tale on his/her own by watching moving pictures, he/she can use causal relationships and compose stories that are easy to understand.

3. Development of the Software
3.1. Components of the Contents

This software presumes that a child and an adult are using it together. The tale is divided into three sections: introductory, development, and solution. In the introductory section, an adult narrates the introduction of the story to the child. Next, the child creates a story in the development and solution sections.

The Introductory Section

In the introductory section, an adult narrates the introduction of a story to the child. In this section, some accidents take place and the character experiences misfortunes and troubles. Next, the software requires the child to think of a solution, and they are engaged in the act of completing the story.

The Development Section

In the development section, the child prepares the next stage of the story. Initially, the child uses certain functions of this software to understand the story. After the child has developed the story in his/her imagination, he/she narrates the story to the adult.

The Solution Section

In the solution section, the child develops the last stage of the story and concludes it. Initially, the child uses certain functions of the software to understand the story. After the child has developed the story in his/her imagination, he/she narrates the story to the adult.

I developed “The adventure of Picke” as the contents for an experiment (Fig. 1, 2). The hardware constitutes a tablet PC, which is operated through direct inputs via the touch panel, a mode that a child also tends to use. The contents are created through Flash.

3.2. Functions of the Software
The Introductory Section

In this section, the animation for a story is displayed. An adult reads aloud the captions of the animation and turns the page by clicking on the “next” button. The functions of this section are listed below (Fig. 1).
The Development and Solution Sections

The main functions that the child uses in the development and solution sections are as follows:

The Characters

There are a hero and another character in the story. The number of characters in one section is two because the child can make a story easily and concentrate on the story. The child can change the character's facial expressions and actions.

The function of character's facial expressions

The children at around the age of five and a half years come to be able to understand the emotion of delight, anger, sorrow, and pleasure gradually. When the child changes the character’s facial expression, he/she thinks carefully about the character’s emotional states. Therefore, the function button that the child can change the character’s facial expression is prepared. The protocol about character’s emotional states will be promoted.

The function of character’s actions

When the child changes the character’s action, he/she thinks carefully about the relationship of characters and the next stage of the story. In addition, the child can use causal relationships and compose stories that are easy to understand by watching moving pictures. Therefore, the function button that the child can change the character’s action is prepared. The protocol about character’s action will be promoted.

The function of visual scene

When the child changes an animation of a visual scene, he/she thinks carefully about the context of a story. In addition, the child can use causal relationships and compose stories that are easy to understand by watching moving pictures. Therefore, the function button that the child can change the visual scene is prepared. The protocol about the visual scene will be promoted.

These sections include certain functions that the children operate using buttons. When a button is clicked, the corresponding action takes place, such as the appearance of a character, change in a character’s facial expression, or the display of an animation. The functions of these sections are as follows (Fig. 2).

1. The animation screen
   An animation of the characters and scene is displayed when this button is selected.

2. The “scene” button
   This button pertains to the scene that is displayed in the background of the animation. If this button is clicked, the scene on the screen will change.

3. The page function
   This function is used to turn the page by clicking on the “next” or “back” buttons.

4. Story captions
   These are the story captions that an adult reads aloud to the child.
(4) The “action” button
An animation of the character’s action is displayed when the “action” button is selected.
For example, characters playing together, characters fighting with each other, or a character going somewhere.

(5) The “item” button
An animation of a hint to the solution is displayed when the “item” button is selected.

(6) The “visual scene” button
An animation of a visual scene is displayed when the “visual scene” button is selected.
For example, the scene changes to rainfall, snowfall, clear weather, or to nighttime.

(7) The “next scene” button
An animation of a development in the story is displayed, and the scene changes when this button is clicked.
4. Experiment and Evaluation

4.1. Experiment Method

I conducted an experiment to test the effectiveness of this software. One group of children developed narratives using the software, and another group developed narratives by only using paper. I compare the protocol data of the software and paper groups.

**Participants**

Forty-two children (age = 5–6 years; 19 boys and 23 girls) from kindergarten participated in the experiment. Software group: 22 (10 boys and 12 girls) 
Paper group: 20 (9 boys and 11 girls)

**Activities**

Children developed a narrative about “The adventure of Pickle.” In the introductory section, an adult narrates the introduction of the story to the child using this software. Next, the child develops a continuation of this story by using the tool explained above. 
Software group: used this software 
Paper group: used paper (3 scenes, 5 characters)

4.2. Coding

The children’s narratives were transcribed verbatim from the videotapes. As described below, the transcripts were coded in order to track the number of propositions and the indicators of narrative categories.

**Coding propositions**

Propositions were defined as independent clauses that include a subject and a verb. As in previous studies (Akita et al. 1987), propositions were coded when subjects or verbs were implied. The methods for coding narrative indicators were variations of those employed by Akita et al. (1987). Each of the variables comprising narrative indicators are presented in Tab. 1. In addition, the number of causal relationships between events was counted.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actions</td>
<td>Responses identifying activities in the event</td>
<td>“He was gone.” “He is waiting.”</td>
</tr>
<tr>
<td>Object States</td>
<td>The subject of the sentence is the object, and the sentence explains the status and attributes of the object</td>
<td>“It is high.” “It is silent.”</td>
</tr>
<tr>
<td>Character States</td>
<td>The subject of the sentence is the character, and the sentence explains the status and attributes of the character</td>
<td>“He is alone.” “He is similar to a dog.”</td>
</tr>
<tr>
<td>Emotional States</td>
<td>The proposition of the subject indicates the emotional state of the character</td>
<td>“He is sad.” “He thinks nicely.” “He has a good idea.”</td>
</tr>
</tbody>
</table>
4.3. Results

Based on the above coding propositions, the protocol data of the children’s narratives is compared between the software group and paper group using the Mann-Whitney U Test.

The number of propositions used by the children in the software group is slightly greater than that of the paper group (U = 94.5, *P < .05). Next, the number of propositions of each category is compared. The number of propositions about the object states used by the software group is higher than that of the paper group (U = 39.0, **p < .001). Finally, the number of prepositions used to describe the emotional states is also higher for the software group than for the paper group (U = 38.5, ***p < .001). With regard to actions and the character states, there was no difference between the two groups. Akita et al. (1987) found that initially, children use propositions related to actions most often. As they develop, their use of propositions related to emotional states increases. The following narrative excerpt provides an example of this experiment.

<table>
<thead>
<tr>
<th>Child from the paper group</th>
</tr>
</thead>
<tbody>
<tr>
<td>The rabbit gives the balloon to Picke.</td>
</tr>
<tr>
<td>And Picke climbs a tree and flies the balloon.</td>
</tr>
<tr>
<td>He says to Garko, “Please catch this balloon!”</td>
</tr>
<tr>
<td>When Garko breaks the balloon, they fall down at an uncanny speed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child from the software group</th>
</tr>
</thead>
<tbody>
<tr>
<td>The rabbit comes here with the balloon.</td>
</tr>
<tr>
<td>And then Picke could reach the sky.</td>
</tr>
<tr>
<td><strong>&lt;click the “balloon” button&gt;</strong></td>
</tr>
<tr>
<td>The rabbit gives the balloon to Picke.</td>
</tr>
<tr>
<td>And Picke climbs a tree and flies the balloon.</td>
</tr>
<tr>
<td>He says to Garko, “Please catch this balloon!”</td>
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<tr>
<td>When Garko breaks the balloon, they fall down at an uncanny speed.</td>
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</tbody>
</table>

The number of causal relationships between events is counted and compared between the software and paper groups. The software group had a higher proportion of causal relationships than the paper group (U = 37, **P < .01).

4.4. Limitations and Future issue

By using this software, children’s narrative skills are supported. However, there are some limitations of this software. Children combine some causal event parts and make a story by pushing emotion or event buttons offered in the software. Nevertheless, the functional parts of the software are few, allowing children to concentrate on an utterance. However children can’t make the end of the story freely.

Fantasy play also fosters children’s cognitive and language skills. In fantasy play, children practice their ability to represent objects, actions, and feelings with something that stands for them. In order to encourage the development of children’s narrative skills, more convenient and freer functions are needed. I want to improve the function interface.

It is difficult to consider that children are able to develop narrative skills using the software only a few times. Regular daily use of this software, however, will see children’s narrative skills improve eventually to the point of independence. Through children play with this software on a daily basis, children will become able to make good narrative productions without using software. Therefore the software needs some functions that enable children to make a variety of stories on a daily basis. I want to design a new interface containing a far greater array of options, enabling daily use at kindergarten level.
5. Conclusions

In this study, the target that a child’s narrative production should achieve by using this software is set as below.

1. When a child develops a tale by setting up the pictorial information by him/herself, the child will be stimulated and his/her narrative production will increase.

2. When a child develops a tale by setting up the characters’ facial expressions by him/herself, the protocols on the characters’ emotional states, which are difficult for young children to grasp, are promoted. Further, when a child develops a tale by setting up the visual scene and the characters’ actions by him/herself, the context of utterance will become more varied.

3. When a child develops a tale on his/her own by watching the moving pictures, he/she can use causal relationships to compose stories that are easy to understand.

The children’s narratives were coded to track the number of propositions and the indicators of narrative categories. This data was then compared between the software and paper groups. Additionally, the category that used a higher number of propositions was examined.

According to these analyses, children’s narrative production increased with the use of this software. The results showed that the proposed system stimulates storytelling and increases the event categories in the protocol of each story. In particular, the causality of the characters’ emotional states are increased by using functions to change facial expressions. Children can also use causal relationships and compose stories that are easy to understand.

References


