Narrative Mathematics Learning: A Practice in Challenge Mathematics

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Abstract: In school mathematics education, the most profound is how to evoke children's emotions to learn mathematics. This study aims to change this situation by a new educational method Narrative Mathematics Learning. Through the practice of Narrative Mathematics Learning in Challenge Mathematics reported in the paper, it is determined that the appearance of specific role can arouse children's attention and improve their verbal communication skills. Meanwhile, by Narrative Mathematics Learning, both the systematization in school mathematics and the application of mathematics in other school subjects are throughout the whole activity. Narrative Mathematics Learning the mathematical perspective and thinking.

Introduction

The new revised Course of Study for the Elementary Schools will be carried out from 2020. The main characteristic of the new revised Course of Study is under the concept as "school curriculum opened to the society". "curriculum management" for the improvement of the quality of education and "active learning" for the improvement of teaching methods has been emphasized. Furthermore, the aptitude and ability needed to be cultivated has been indicated as three pillars which are "knowledge and skills (what to understand and what to do)". "ability to think, to judge and to express (how to use what understood and what can do", and "power towards learning, humanity, etc. (how to engage with society and the world, also to live a better life)". In the study of each subject, this is reflected by to learn everything established horizontal relations among various subjects.

On the other hand, according to this new revised Course of Study for the Elementary Schools, there are some great changes in Arithmetic. In addition to the increased learning contents, mathematical perspective and thinking should be cultivated by the mathematics activities, the one that has been stated as arithmetic activities until now. In order to achieve these objectives, Narrative Mathematics Learning has been practiced in our regular activities named Challenge Mathematics. This paper reports on the first practices of Narrative Mathematics Learning designed to focus on both the longitudinal relationship within mathematics and the horizontal relations between Arithmetic and other subjects should be paid enough attention.

Narrative Mathematics Learning

Narrative Mathematics Learning is an extension of Narrative Learning developed and tested at the Research Center for Development Teaching and Learning at Oulu University, Finland which aimed at the preschool education. Through many experimental works, Hakkarainen and Bredikyte determined that being an educational method, Narrative Learning is based on the theoretical ideas that story/ narrative is a basic principle of human mind and a psychological tool formalizing and unifying human thought and knowledge into thematic units (Hakkarainen & Bredikyte, 2010). In their experimental works, the transition to imaginative role-play, transitory activity between play and learning and transition to school learning are the core of the whole educational approaches. It is believed that studying by Narrative Learning can reach Vygotsky's concept of the zone of proximal development defined as a kind of distance between what a child can do on her own and what she can do in collaboration and with adult guidance (Vygotsky, 1934/1986).

In the field of school mathematics education, the most profound is how to evoke children's emotions to learn mathematics. For this reason, the proactive learning, the ability to express, language activities, and active learning have been put forward successively by the MEXT, Japan. In our view, the role-play can be used in mathematics activities to inspire children's interest of studying.

In our Narrative Mathematics Learning, there is a specific role played by our student. Following the specific role player's narration, the participated children involved into the environment naturally, and help the player to solve the problem willingly.

Additionally, since this is the Narrative Learning based on mathematics, the arrangement of mathematics content, and the application of learnt mathematics knowledge are the key elements. Meanwhile, the narrative is presented as communication by words, mathematical expression, and formula.

Practice Narrative Mathematics Learning in Challenge Mathematics

As a regular activity, Challenge Mathematics 2018 was held on each Saturday afternoon in June. There were 4 rounds. For each round there were over 100 participants who were children with their parents from different primary schools.

At the beginning of the 1st round, the specific role named Segodon appeared suddenly. Segodon (Saigou Takamori), born in Kagoshima, was a famous samurai who led the Meiji Restoration. Due to the hit right of *Segodon*, a drama produced by NHK, Mr. Segodon had become a household name. In fact, the appearance of Segodon created a sensation. The conversation between Segodon and the children treated the history of Japan. Therefore, Segodon succeeded at being a key role through 4 rounds.

Round 1: implementations and findings

Subjects and content: data collection and graph (Arithmetic); name of prefectures in Japan (Social studies)

In the new revised Course of Study for the Elementary Schools, the study of statistics should be intensified. However, the data collection used in statistics seems as too dull to arouse children's interest. For this reason, Segodon who travelled from Meiji period by time machine was designed to inspire children.

Facing the world of the 21st century, Segodon felt sheepish but was consumed with curiosity. Through the dialogue, the children decided to help Segodon to know this world. They collected various data from internet by iPad, made graph for the easy comprehension, such as the amount of primary schools in Japan (**Fig. 1**), the output of different fruits in Japan (**Fig. 2**). Finally, in the group presentation, the children explained to Segodon what is the new in Japan by their graph.



Fig. 1



Fig. 2

Round 2 : implementations and findings Subjects and content: calculation, the binary number system (Arithmetic), the Maya numbers with head variants (Social studies)

After children's careful investigation, Segodon knew the Japan now quite well. He wrote a letter to the children to express his thanks in his own language (Figs. 3 & 4).





However, Segodon's language looks so weird that nobody can read it. Segodon explained that the letter was written in code which was important way for them to win the war at their period. To understand this letter written in code had been children's great desire. Via iPad, hint cards, the algorithm of divided by 2 and group work (Fig. 5), the letter from Segodon was linked together (Fig. 6).

In mathematics, there are different kinds of number systems. Since the number and its calculation are based on the decimal system, the children learn the decimal system even from their daily life. However, the other number systems are also important. For example, being the calculation mode of computers, the binary number system has been the key for human to comprehend the world. In this round, the children got a chance to experience not to learn the binary system.



Fig. 3



Fig. 5



Fig. 6

Round 3 : implementations and findings Subjects and content : polygon, polyhedron (Arithmetic), handicraft (Art and Handicraft)

The purpose of this activity is to help the children to have preliminary understanding on "dot, line and plane". To the children in Grade 3 and Grade 4, they are familiar with 2D figures. With existing knowledge, the children pointed out the number of dot and line of different polygon (**Fig. 7**). Following Segodon's instruction, they began to make polyhedron by straws. After that, the children counted the number of dot, line and plane (**Fig. 8**). Through the handmade activity and the direct impression, the children widened their knowledge from 2D to 3D.



Fig. 7



Fig. 8

As seen in Figures 7 & 8, under Segodon's instruction, the children widened their knowledge. With existing knowledge, the children pointed out the number of dot and line of different polygon. After making polyhedron by straws, the children could count the number of dot, line and plane with the direct impression.

Round 4: implementations and findings

Subjects and content: the measurement of distance, calculation, proportion, Cartesian coordinate system (Arithmetic), the distance between two locations on the map, the map scale (Social studies)

It is time for farewell. Segodon's time machine would launch in Tanegashima, Kagoshima. The children wanted to find a best way on the map for Segodon to reach the harbour (**Fig. 9**), and build a ship for Segodon to sail to Tanegashima.



Fig. 9



Fig. 10



Fig. 11

As seen in Figures 10 & 11, after calculation, if the child made a right answer, she would get a coordinate. Under the team work, all coordinates were collected, and finally the ship was finished.

Discussion

Narrative Mathematics Learning is considered as an educational method for the mathematics activities which stressed in the new revised Course of Study. In the school mathematics education, mathematics is not an isolated subject, it should integrate with other subjects. On my proposal, the scheme of Narrative Mathematics Learning can be described in a 2D Cartesian coordinate system which is all school subjects on X-axis and the mathematics contents on Y-axis. In the practice, even though both the longitudinal relationship within mathematics and the horizontal relations between Arithmetic and other subjects was considered carefully, shortcoming and the rough have been left. However, the appearance of Segodon, the special role is unquestioned. The feedback from the parents showed that their children threw themselves into the activities. As a consequence, Narrative Mathematics Learning will be developed in the next experimental test to achieve the objective of cultivating the mathematical perspective and thinking.

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