

Educational Support for Children with Special Needs: K-12 SNE Kids Touch

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Schools for special needs children need educational tools based on information and communications technology (ICT). ICT is especially effective when used in accordance with each child's disabilities and needs, enhancing their achievements in various subjects and activities and thereby promoting independence. In June 2012, Fujitsu started developing an educational software series to meet the needs of such children, the "FUJITSU Education Solution K-12 SNE Kids Touch" series. This series comprises four software programs: "Let's draw lines!" "Let's write hiragana!" "Let's write katakana!" and "Let's do jigsaw puzzles!" They are equipped with a touch-based interface and are designed for use by children with physical or intellectual disabilities and/or developmental disorders. Their difficulty level can be adjusted to match the child's abilities, educational materials can be added or composed, and the child's usage can be tracked to facilitate follow-up on his or her progress. This paper introduces these programs, describes the trials conducted at special needs schools, and discusses the outcomes.

1. Introduction

Today, the informatization of society is progressing rapidly, and schools are being directed to provide a 21st century education using information and communications technology (ICT). The Japanese government set the goal of providing a tablet device for each elementary school and junior high school student by 2020, and ICT-driven projects are underway in many schools in Japan. They include the School Innovation Project of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Future School Promotion Project of the Ministry of Internal Affairs and Communications (MIC).

ICT utilization is especially effective for special needs education (SNE) because it enables the flexible provision of educational materials based upon each child's disabilities and needs.¹⁾ It provides several significant benefits:

- it helps a child overcome his or her disabilities and may even help reduce their degree;
- it promotes effective learning while having fun;
- it enriches the child's social participation experience.²⁾

However, there is less educational software for

special needs education than there is for general education. In addition, developing software for education is difficult, and many educators are still unfamiliar with such software. Fujitsu has thus been developing a series of educational software programs—the "FUJITSU Education Solution K-12 SNE Kids Touch" series—to provide a better learning environment for children with special needs.

This paper describes the functions and features of the K-12 SNE Kids Touch series programs and the trials conducted at special needs schools.

2. Configuration and operating environment

The K-12 SNE Kids Touch series is composed of four software programs: "Let's draw lines!" "Let's write hiragana!" "Let's write katakana!" and "Let's do jigsaw puzzles!" These four programs are designed to develop the fundamental skills of children with special needs, such as intellectually handicapped children, physically disabled children, and developmentally disabled children. It provides four features:

- the user interface is touch-based;
- the difficulty level can be adjusted to match the

child's abilities;

- educational materials can be added or composed;
- the child's usage can be tracked to facilitate follow-up on the child's progress.

The system runs on the Windows 7 (SP1), Windows 8, and Windows 8.1 operating systems and requires a monitor with a screen resolution of 1280 × 768 or higher and Microsoft .NET Framework 4, 4.5, or 4.5.1. Microsoft Excel 2010 or later is required to view the learning history.

3. Let's draw lines!

To write well, one must draw various types of lines correctly because letters and characters consist of various types of lines. Drawing lines requires hand-eye coordination. The "Let's draw lines!" program helps to improve hand-eye coordination through line-tracing practice with fun play-oriented tasks such as feeding fruit to a hippo or helping a girl brush her teeth.

When the program is started, it shows a menu screen of eight option buttons for line type, and the child chooses a type: horizontal lines, vertical lines, diagonal lines, lines with up to three bends, curved lines, and geometric shapes. After a type is chosen, a picture of a piece of fruit is shown on the start point of the line, and the child carries it into the hippo's mouth at the end point of the line by dragging with a finger or pen. [Figure 1 (a)] Then the hippo eats it and says, "Oh, this is yummy!" Each time the child succeeds in the task, a praise screen is displayed, and the hippo says, "Thanks, I enjoyed it!" It is also possible to select other game scenarios to suit the child's interests, such as feeding

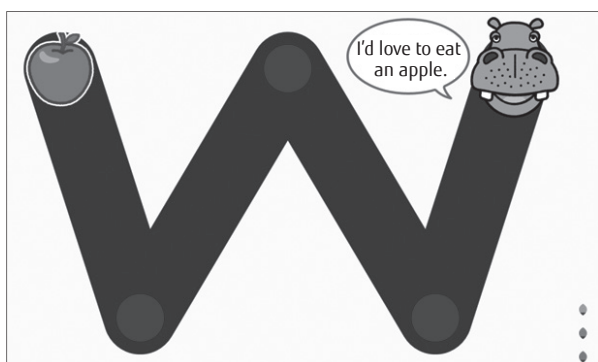
fruit to a gorilla, feeding cake to a boy, brushing a girl's teeth, or watering flowers with a watering can.

On the line-tracing screen, flower buds and flowers are displayed to indicate the child's progress. Flower buds are initially displayed on the right side of the screen, and one blooms each time the child succeeds in a task. The child can choose an option to mark the location of corners if the practice line has a corner.

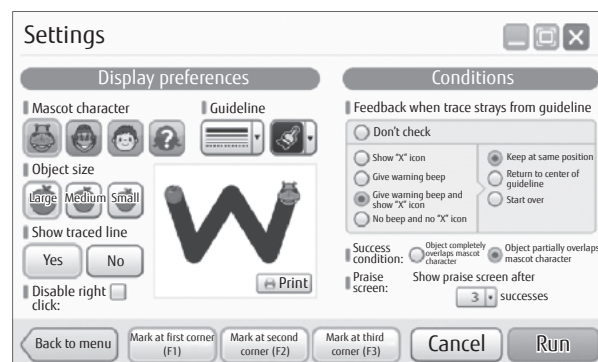
The settings screen [Figure 1 (b)] is brought up by a long press at the top of the screen or a right-click on the line-tracing screen. From this screen, various parameters can be easily set in accordance with the child's stage of development. The parameters include the width and color of the guide line, the size of the piece of fruit, whether or not to give feedback when the trace strays from the guide line, and the number of successes for displaying the praise screen. The task can be made more challenging, for example, by setting the guide line narrower and activating the trace-checking feature. In addition, children can practice the same line-tracing using pencil and paper because the program has a printing function.

4. Let's write hiragana/katakana!

At the initial stages of learning to write characters, children practice tracing characters following the correct stroke order. They also learn characters by matching specific objects with corresponding words, like a picture of an apple and the word "apple" (in either hiragana or katakana), or a picture of a friend and the friend's name. The "Let's write hiragana!" and "Let's write katakana!" programs help to improve object-word



(a) Line tracing practice screen



(b) Settings screen

Figure 1
Let's draw lines!

matching skills and handwriting skills through matching a picture or movie with a displayed word and tracing each character.

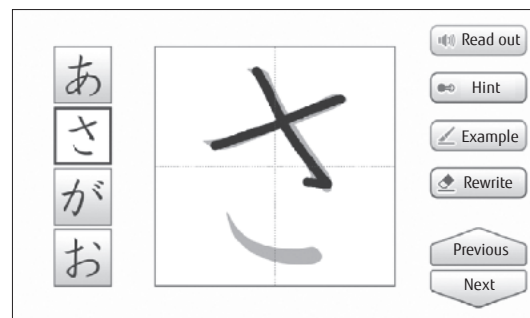
When each software program is started, it shows a menu screen for selecting a set of words (in hiragana or katakana). There are preloaded samples containing words composed of two or three characters and words to describe action. The child chooses a word, and the program shows the word-matching screen [Figure 2 (a)]. The screen has character cards, a sample word, and the picture. The child picks the cards one by one to make a correct word. After this matching is completed, the program shows a handwriting-practice screen, and the child traces the shape of the character shown at the center of the screen to complete the correct character [Figure 2 (b)]. If the “read out” button is pressed, the program plays back an audio recording of the character. If the “Hint” button is pressed, the program shows the start and end points of the next stroke. If the “Example” button is pressed, the program draws the stroke. If the

“Rewrite” button is pressed, the program erases the handwritten stroke from the screen. After the child has finished writing the character, he or she presses the “Next” button to switch to the practice screen for the next character. When the child has written all the characters, a praise screen is displayed with the child’s own handwriting. This screen also displays flower buds and flowers to indicate the child’s progress.

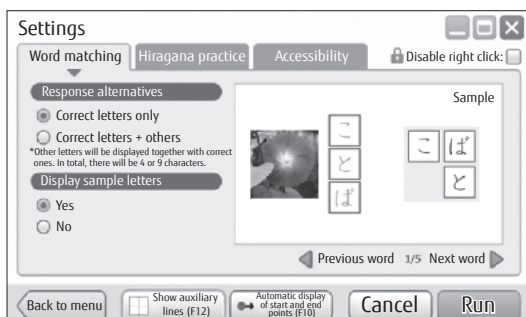
The settings screen [Figures 2 (c), (d)] is brought up by a long press at the top of the screen or a right-click on the word-matching screen or the handwriting-practice screen. From this screen, various parameters can be easily set in accordance with the child’s stage of development. The parameters include the options for the character cards and sample characters on the word-matching screen, the line type of the sample character on the handwriting-practice screen, the display speed, and whether or not to check the stroke order. The task can be made more challenging, for example, by activating the “correct characters + others” option on the



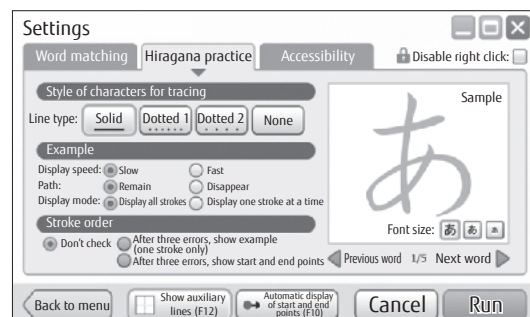
(a) Word-matching screen



(b) Handwriting practice screen



(c) Settings screen 1



(d) Settings screen 2

Figure 2
Let's write hiragana!

word-matching screen so that characters unnecessary for creating the word are added randomly.

In the option settings, it is possible to create or delete word sets of hiragana or katakana in accordance with the child's interests. The word sets can be enhanced by importing images and/or movies and changing the word order. In addition, children can practice the same handwriting using pencil and paper because the program has a printing function.

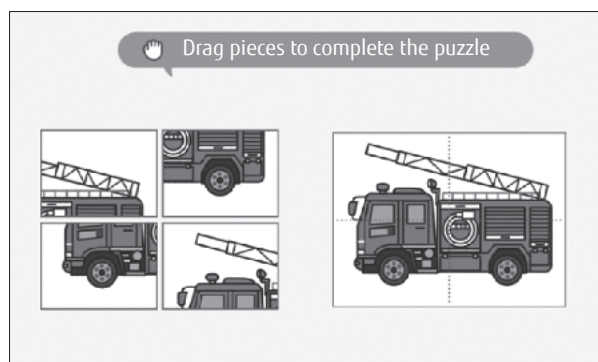
5. Let's do jigsaw puzzles!

The recognition and discrimination of shapes and colors requires perceptual integration skills to enable information received through the eyes to be transformed into meaningful information. "Let's do jigsaw puzzles!" helps to improve perceptual integration skills through putting together jigsaw puzzles with 2–9 pieces.

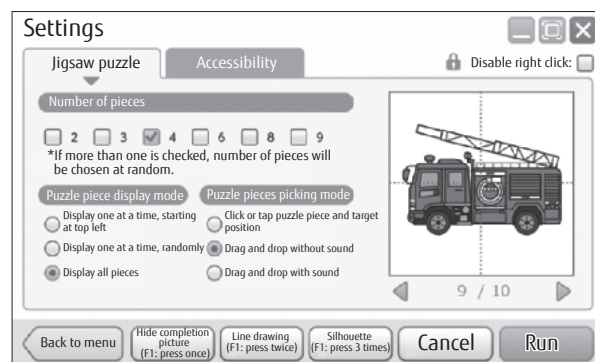
When the software program is started, it shows a menu screen for selecting a set of jigsaw puzzles. There are preloaded sample puzzles of animals, musical instruments, and various types of transportation. The child chooses a puzzle, and the program shows the jigsaw puzzle screen [Figure 3 (a)]. The puzzle pieces are on the left side, and the completion picture is on the right side. The child carries the puzzle pieces to the corresponding area on the completion picture by dragging with a finger or pen. After the child assembles the pieces into a picture, a red circle is displayed on the completed puzzle, and a "ding-dong" sound is played. If the puzzle is an animation or movie, the animation or movie is played.

The settings screen [Figure 3 (b)] is brought up by a long press at the top of the screen or a right-click on the jigsaw puzzle screen. From this screen, various parameters can be easily set in accordance with the child's stage of development. The parameters include the number of pieces, the mode for displaying the puzzle pieces, and the mode for selecting and moving the puzzle pieces. The task can be made more challenging, for example, by increasing the number of pieces and changing the completion picture display mode to silhouette style. It is also possible to create or delete sets of jigsaw puzzles in accordance with the child's interests. The jigsaw puzzle sets can be enhanced by importing images and/or movies and changing the display order.

Selection and positioning of the puzzle pieces can be made easier for physically disabled children by setting the "auto scanning" option to "yes." This causes an indicator to move from puzzle piece to puzzle piece in the left hand panel. The user selects a piece by pressing the Enter key when the indicator is on the the desired piece. This causes a "focus rectangle" to be activated in the right hand panel, as shown in Figure 4. This rectangle automatically moves from location to location in the puzzle, with the switching time as set in the options. The user selects a location to position the piece by hitting the Enter key when the focus rectangle is at that location. If the selection is correct, the piece is placed there. If it is incorrect, the rectangle starts moving again.



(a) Jigsaw puzzle screen



(b) Settings screen

Figure 3
Let's do jigsaw puzzles!

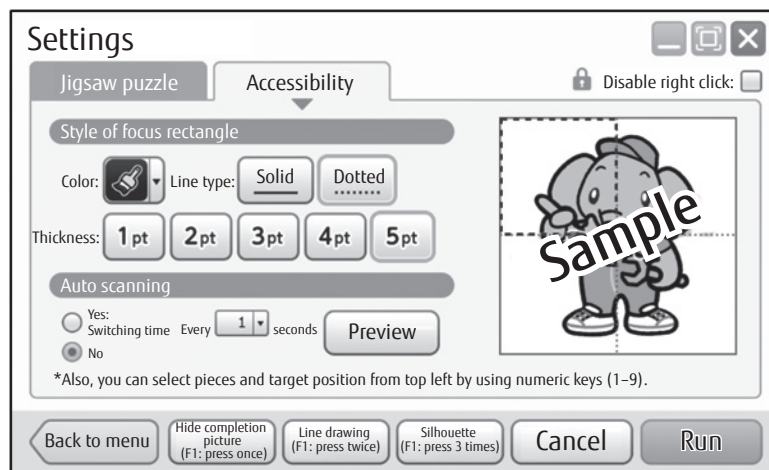


Figure 4
Accessibility settings screen.

6. Common functions

Three functions are common to the K-12 SNE Kids Touch series programs.

1) Learning history

Software programs for children with special needs must have a learning history function.³⁾ Each program in the K-12 SNE Kids Touch series has a menu for registering and deregistering users and setting the options for each one. These settings are saved and used each time the user uses the program. An icon is generated on the desktop for each registered user. Starting a program by clicking on a user's icon causes his or her learning activities to be automatically recorded in a local history folder.

Startup of the learning history viewer enables the learning history data to be imported and various types of information to be viewed. This information includes learning dates and times, settings, results, and paths to files containing the user's drawings. Some information can be plotted on charts automatically, making it possible to assess each user's progress.

2) Accessibility

While a physically disabled child can have trouble operating most software by touch or by using a mouse or pen, the K-12 SNE Kids Touch series programs can be operated by using a combination of a switch interface^{note 1)} corresponding to the numerical keypad,

note 1) An adapter connects the PC to external switches through a USB or other interface.

the Enter key, and the Tab key and an external input switch^{note 2)} that matches the type of disability.

For example, locations that accept touch or left-click operations can be activated by using the Tab key, the Enter key,⁴⁾ or the numerical keypad.

3) Import and export of educational materials

The import and export of educational materials like puzzle sets and hiragana/katakana sets are supported. These sets can be used on other tablet PCs on which the same software programs have been installed.

7. Trials and feedback

From October 2012 to February 2014, trials using tablet PCs with the K-12 SNE Kids Touch series programs installed were conducted in the elementary and junior high school sections of four special needs schools, including the Kagawa University Affiliated School [Figure 5 (a)]. The feedback from the students' teachers included the following comments:

- 1) With the "Let's draw lines!" program, marking the corners improved the students' drawing skills and reduced the number of stray lines. In addition, the students were motivated to practice because they could choose the line style and practice at their own pace.

note 2) Input devices for the disabled include push switches and grip switches. They are operated by using a part of the body that can perform voluntary movement.



(a) Trying out "Let's draw lines!"



(b) Trying out "Let's write hiragana!"

Figure 5
Testing and evaluation.

- 2) Because each software program has a different praise screen, the students could challenge themselves again and again until they were satisfied, especially for the "Let's write hiragana!" and "Let's write katakana!" programs, because they could see the characters they wrote on the praise screen [Figure 5 (b)].
- 3) With the "Let's do jigsaw puzzles!" program, the visual and audio feedback the students received when a puzzle was completed made the experience more engaging than solving ordinary jigsaw puzzles.
- 4) Using the learning history made it easier to follow each student's progress. This should improve our teaching because we can understand their progress objectively.

The teachers made four specific requests:

- 1) Make the screen layout reversible to accommodate left-handed children.
- 2) Support kanji (Chinese characters) as well as hiragana and katakana.
- 3) Make the puzzle pieces in the "Let's do jigsaw puzzles!" program various shapes, like ordinary jigsaw puzzle pieces, rather than square only.
- 4) Add a function for switching between pen input and touch input so that, if the hand holding the pen touches the screen when using the pen device on a tablet PC, the software program does not detect an error.

On the basis of these comments, we improved the operability and functionality of the K-12 SNE Kids Touch series programs.

8. Conclusion

We have introduced the functions and features of the K-12 SNE Kids Touch series software programs and have described the trials conducted in special needs schools. Software programs that match the type and degree of disability are needed to utilize ICT in special needs education. In the development of the software, it is important to validate efficacy again and again for special needs education to improve the operability and functionality. We plan to improve the K-12 SNE Kids Touch series programs by making them compatible with various operating systems and by adding a function for storing the learning histories on a server.

Fujitsu aims to enrich ICT-driven special needs education to help children with special needs to be able to participate in society and live independently in the future. We will continue developing educational software programs that match the type and degree of disability.

In closing, we would like to give a special thanks to all the students and teachers in the special needs schools that participated in the trials of the K-12 SNE Kids Touch series.

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