UX Design for ARROWS Tab Q506/ME Tablet for Schools Developed Based on User Feedback

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Education is an upcoming market for tablet devices, which have already been widely introduced in business contexts. In an effort to promote ICT in education, the Japanese government and the Ministry of Education, Culture, Sports, Science and Technology are encouraging schools to provide each student with a tablet. Fujitsu offers the ARROWS Tab Series for this purpose, but some trouble with the products meant that we struggled in this market. Given this situation, we focused our product development on the user experience (UX) of schoolchildren, and addressed various kinds of feedback from classrooms. These efforts led to the development of the School Tablets ARROWS Tab Q506/ME and Q507/PE. As a result, these products achieved a market share of 67% in FY2016. This paper explains this Q506/ME in terms of the on-site insights, UX design, and market responses.

1. Introduction

In April 2011, the Ministry of Education, Culture, Sports, Science and Technology of Japan announced a policy to bring education up to date with the growing information society, in the Vision for ICT in Education. The Japanese government launched several programs in 2013 through the IT Strategic Headquarters, such as one to provide IT devices to every student at schools.

Recent Monozukuri (Japanese way of manufacturing) veers toward highly specialized product development, with a narrow focus on specific target users, while searching for ways to differentiate the products from their competitors. Fujitsu's Windows tablet family for business use, the ARROWS Tab Series, has been developed to cater to diverse needs of customers across industries, and the tablets developed for the education market represent one of these specially developed products. The history of Fujitsu School Tablet is shown in **Table 1**. The common features of the series include the 10.1-inch LCD screen and the Intel Atom processor for the CPU.

Fujitsu first launched its School Tablet in 2013, and in the early days, the product struggled due to faults and performance problems at the user end, partly attributed to a lack of know-how in the product development for this new market. To address the situation, we started by asking questions such as why the products that were competent in business contexts failed in the educational context, how students handled the product in classrooms, what factors were there that led to malfunctions and/or faults, and what the students and teachers expected of the School Tablets. Although investigations into the causes of faults and troubles had been pursued since the product launch, we started the trouble-shooting process for School Tablets by conducting field research in school classrooms.

Based on the findings from this, we pursued the user experience (UX) best optimized for schoolchildren. The UX design was applied to the process of product development in this way from the product concept and general form through to the design of detailed parts. Subsequently, Q506/ME was launched in 2015, designed with an optimized UX based on data on actual usage in classrooms.

This paper describes this School Tablet Q506/ME and its UX-based design and development.

2. Findings from classroom observations

Fujitsu conducted the Learning Project of Tomorrow[1)] between September 2014 and March 2016. Through it, we made classroom observations at a total

Table 1
School Tablet evolution–ARROWS Tab

Product name (launch date)	Major specifications	Features	Product image
ARROWS Tab Q584/H (October 2013)	• OS: Windows 8.1 • CPU: Intel Atom Z3770 • Display: 10.1 inch WQXGA	"Handy, high-resolution tablets with waterproof capability" A model with water/dust/chemical-proof capability that withstands use in a tough environment.	
ARROWS Tab Q555/K (October 2014)	• OS: Windows 8.1 • CPU: Intel Atom Z3795 • Display: 10.1 inch WUXGA	"Lightweight tablet with longer-lasting battery power" A model with long-life battery performing for 17 hours*–making possible day-long use in the field without recharging.	
ARROWS Tab 506/ME (October 2015)	• OS: Windows 8.1/10 • CPU: Intel Atom x5-Z8500 • Display: 10.1 inch WUXGA	"Reliable tablet for education" A model for school with the form and robustness that meet the demands of the context and offering a UX based on feedback from real classrooms.	
ARROWS Tab Q507/PE (October 2016)	• OS: Windows 8.1/10 • CPU: Intel Atom x5-Z8550 • Display: 10.1 inch WUXGA	"Reliable tablet for education" A second-generation model for school with enhanced features, design, robustness, and ease of use optimized for a classroom.	

* Measured using the JEITA battery run time measurement method (Ver. 1.0) provided by the Japan Electronics and Information Technology Industries Association.
Tested conditions: using only the main unit, with power-saving control on, and the battery fully charged. Actual battery hours may vary depending on the conditions under which the device is used.

of six primary and junior-high schools (five schools in Japan and one school in Thailand). This project provided the target classrooms with tablet devices (one for each student or each group), and observed the classes in which the devices were used. Major findings from these observations are as follows:

1) School desks are standardized by Japanese Industrial Standards (JIS) to be 400 mm (500 mm in the new JIS standard) in depth and 600 mm in width. This is the surface area on which all the items for lessons are placed, including textbooks, notebooks, pen cases, and the tablet. Some students were less careful than others in handling objects, and they sometimes dropped the tablet onto the floor by mistake, causing damage to the device. We learned from this that the design needed to take into consideration the tablet size, as the device was used on the limited desktop area.
2) A tablet pen is used more often in the classroom than in the office context. However, younger students often struggled with the pen, unable to render on the screen what they wanted to express. Conventional tablet pens are different from ordinary pencils sensually, and they have some issues in terms of rendering due to the visual gap between the pen tip and the contact point on the LCD screen surface, as well as of the tracking performance. Meanwhile, the students were given assignments in paper form as before despite the availability of the tablets, for the ease of management and secure storage. Some students were seen writing their assignments with a pencil and paper directly on top of the keyboard. Considering that the students were at the stage of learning how to write correctly in an appropriate posture, some arrangements had to be made.
3) Tablets are used in many tasks, including researching, writing, copying, and communicating. However, using tablets posed the risk of interrupting the course of the class because an unexpected failure of the devices due to breakdown, battery depletion, etc. could not be handled promptly. It is thus important that tablets can be used readily

in classes without causing undue concerns about malfunctions. Network maintenance was also an important point of consideration, as the use of pictures, videos, and sounds via a network is increasing in active learning classes.

4) The scope of tablet use has extended from classrooms to playgrounds, gymnasiums, science labs, craft rooms, and even to field trips. Therefore, the devices need to be equipped with water/dust-proof and vibration/shock-resistance features. When students use tablets standing up, the tablets may be dropped from a height of 1 m, and the shock on impact is greater than a fall from a desktop.

5) A built-in camera is used very often, on such occasions as plant observations and sporting movement observations in a gymnasium. However, in places with poor lighting, such as a gymnasium, the images were blurred and insufficient exposure made the captured images not usable for study purposes. Therefore, enhancing the camera features was another challenge to address.

6) When the students were taken out from the classroom, they carelessly carried the tablets in a basket, sometimes piled up in there. In this condition, the LCD is placed under significant stress. High-school students were sometimes allowed to take the tablets home to do assignments, and in this situation, some of them carried the device on a bicycle, subjecting it to an unexpected level of vibration. Therefore, School Tablets need high rigidity and robustness.

3. Concepts for the development of Q506/ME

We deliberated the product concepts with the product planning, design, and development divisions based on the findings of the classroom observations. As a result, the following two concepts were developed.

3.1 Realizing the form and robustness suitable for the learning environment

First, we worked on development to enhance the robustness of the main body based on the findings from the classroom observations regarding the handling of tablets. The model design also focused on the compatibility with the daily learning environment with users in mind, taking into consideration the area the tablet occupies on the desktop, ease of carrying, and handling.

1) Enhanced robustness

The tablet was designed with a thicker LCD frame, rounded corners, and a shock-absorbent internal structure, to minimize the risk of damage to the LCD. The casing adopted a metal frame to protect the internal parts and motherboard. The top cover was screwed onto the frame to increase the robustness and to prevent the outer casing from being displaced. The effectiveness of these measures has been verified with regards to strength and durability in a test based on classroom usage. Performance has been also tested with regards to the water/dust-proof function.

2) Coordination with other items on the desktop

The following measures were taken to minimize the area taken up by the tablet on the desktop, and to prevent accidental falls due to misplacement or the tablet's biased center of gravity.

- Downsizing

The overall dimensions were reduced by 18 mm in height and 1.5 mm in width while maintaining the LCD size (10.1 inch) to minimize the area occupied by the tablet on the desktop (**Figure 1**). The auxiliary keyboard was also downsized by 18 mm in height. Bumpers were added to the keyboard, so that the tablet could be rested on top without touching the keys. This design contributed to reducing the area occupied by the tablet on the desktop and preventing accidental falls due to misplacement.

- Lowered center of gravity (with the keyboard attached)

The body was downsized in the up/down direction and the battery was repositioned in the lower part of the tablet. These changes have lowered the center of gravity, and enhanced the stability of the device when attached to the keyboard. This helped to reduce unintended collapses on, or falls from, the desktop during touch-typing.

- Non-sliding keyboard

In order to keep the tablet in place on the desk, five rubber grips were attached to the back of the keyboard.

3) Easy to hold and handle

Assuming that students will hold the bottom

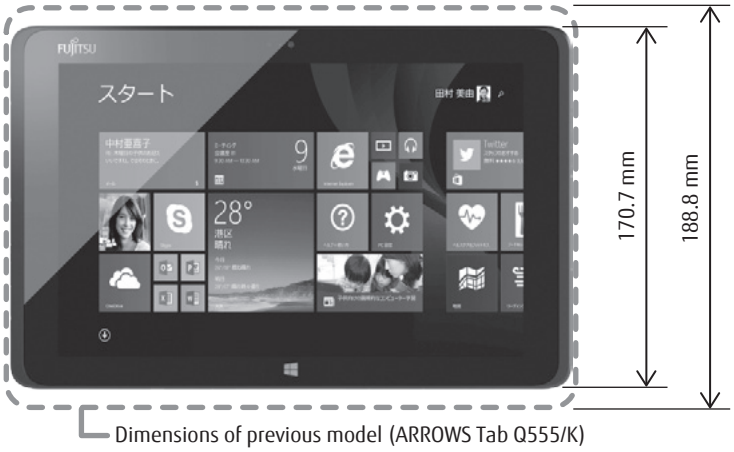

Figure 1
Compact design.

of the tablets with both hands, interfaces and a pen-holder were moved to the upper part of the main body (**Figure 2**). The back of the body is dot-textured to give better grip, and this, together with the lowered center of gravity, has enhanced the stability of the device while it is being handled.

3.2 Tablet pen and camera ultimately optimized for learning purposes

A tablet pen is used in many exercises, such as learning kanji strokes, drawing graphs/diagrams in mathematics, and writing opinions during group discussions, and is thus considered an important feature. A built-in camera needs to produce high-quality images to allow effective recording and viewing in plant observations, sporting movement verification/correction, and other activities. Taking these points on board, we worked on the development as follows:

1) Development of tablet pen with pencil-like performance

We aimed to achieve a tablet pen performance on an LCD that was closer to writing with a pencil on paper. This was achieved by finding the best combination of materials for the pen tip and screen. We also pursued a writing sensation that corresponded to the pencils most often used at schools. We then set a target level of accuracy and continued fine-tuning the developed pen in order to eliminate the visual gap between the pen tip and LCD, and the tracking delay. The tablet pen thus developed has a hexagonal cross-section like most ordinary pencils. This pen is made available as an optional item.

2) Development of performance-oriented camera features

The objective for the camera development was to realize "a camera capable of capturing side-on images of a student jumping over a vaulting horse in a poorly lit gymnasium without a blur" as cameras were often used for this purpose in this condition. We repeatedly tuned the sensitivity and exposure settings, and tested the camera performance under the aforementioned conditions. As a new feature, a sports mode was added to allow agile image-capturing. Set in this mode, the camera operates at faster shutter speeds, making it possible to capture images of fast-moving objects as appropriate for use in classes.

4. Leveraging UX design in product promotion

We launched a dedicated website, the School Tablet, to reach a wider range of market stakeholders and promote these unique UX designs realized in Q506/ME.[2)] On this website, the features explained above are given names which convey the concepts employed in the UX design.

- School Ratio

The body design adjusted in depth to achieve an optimized fit on the school desktop

Figure 2
Tablet grip (bottom part) and interface/card slots (top part).

- School Face
  The reinforced LCD-peripheral design
- School Layout
  Enhanced portability and interface-connectivity

5. Conclusion

In this paper, we described the development of School Tablet Q506/ME with a UX-based design. The product has been enhanced in various detailed ways that meet the possible requirements for use in real classrooms. The model received the 2016 Kids Design Award in recognition of the design's quality to enhance children's security and safety.[3)]

As stated in this paper, a UX design enhances the features of, and adds value to, products that can help drive business expansion by garnering new markets and new users.

Fujitsu launched Q507/PE[4)] in October 2016 as a successor of Q506/ME with enhanced features and a design to better suit the needs in the field. Tablets will be the key device in future ICT-enhanced education. Fujitsu will continue its endeavor to develop and produce products that fully embrace customer needs.

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