

離散数学の論理的な教育用アプリのiOS上の開発に関する教育

An Application for logical Education of Discrete Mathematics on iOS

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1. Social Background

When we study Mathematics of the School Education in elementary school, junior high school, and high school in Japan, logicality is desired repeatedly [1] [2] [3]. We consider that logicality is one of the most important studying Mathematics of the School Education.

2. Existing Applications

First of all, we introduce existing various application for education.

2.1 e-Text

e-Text(electronic text) is *general term* for any document that is read in digital form, and especially a document that is mainly an educational text [4] [5]. A computer based book of

art with minimal text, or a set of photographs or scans of pages, would not usually be called an “e-text”. The term is usually synonymous with e-book.

2.2 iTeX viewer

iTeX viewer is a free application to use the digital contents which the medical study offers in iPad [6]. To use this application, you can read the books of “medical study e-Text” in iPad.

2.3 Digital text in Japan

Digital text is Educational Application that the Ministry of Education, Culture, Sports, Science and Technology considers introduction to elementary schools and junior high schools

by 2020 [7] [8]. This application has basic functions of edit, movement, addition and elimination.

3. iOS

iOS is a mobile operating system created and developed by Apple Inc. exclusively for its hardware. It is the operating system that presently powers many of the company's mobile devices, including the iPhone, iPad, and iPod touch. It is the second most popular mobile operating system globally after Android by sales [17].

4. Motivation of our Research

We recall once again, logicity is one of the most important studying Mathematics of the School Education. But these Existing Applications, specially, Digital text, are not logical. So we consider that the Logical Educational Application is required.

5. What is “Logical” :An logical Education

There are five points that we consider to be important. These are “What we need to show”, “Symmetric”, “Detective”, “Step by step” and “Interactive”.

5.1 What we need to show

When we do not know procedure of proof, we cannot solve. So, need to know what we need to show.

5.2 Symmetric

Discription is sometimes parallel. We can compare difference of proofs by making it symmetric visually.

5.3 Detective

Detective is to expect and argue unknown things with known things.

5.4 Step by step

We can obtain a solution to deduce gradually when we solve a problem.

5.5 Interactive

There are various methods to show solution of proof: For example, to show all of sentences, to show oneline sentence at a time, to show sentences parallely, etc. So students can select a method as they can learn.

6. Implemented Application

An application that we implemented to proof associative law of sets is introduced here:

$$A \cup (B \cup C) = (A \cup B) \cup C. \quad (1)$$

6.1 What we need to show

We can know how to solve a problem by making clear what is goal of a problem (see Fig. 1).

6.2 Symmetric

Fig. 2 shows the whole proof of equation (1). This consists of two columns. One side shows “ $A \cup (B \cup C) \supset (A \cup B) \cup C$ ”. Other side shows “ $A \cup (B \cup C) \subset (A \cup B) \cup C$ ”. They are located symmetrically. As a result, learners can understand the parallelness of the description of the proof.

6.3 Detective

It is possible to make learners consider what continue after by not giving all sentence of proof (see Figs. 3-6). For example, to stop only “(ii) $x \in B \cup C$ のときさらに” in Fig. 4 then additional, “(ii-1) $x \in C$ または (ii-2) $x \in B$ となる。” in Fig. 5, they will think continuation of proof. So, to stop makes to think.

6.4 Step by step

To give learners hints little by little, they can learn certainly stepwise (see Fig. 3).

6.5 Interactive

Learners can choose a solution method they like to tap the buttons in Figs. 1-6. To tap the button “表示” in Figs. 1-6 every time, one-line sentence appears. When students want to know proof early they can see to tap the button “一括表” in Figs. 1-6. If students still do not understand, they will be able to do to tap the button “概要/表示” in Figs. 1-6.

7. Result and Future Works

An application implemented in iOS. Implemented application includes “What we need to show”, “Symmetric”, “Detective”, “Step by

step” and “Interactive”. One of future works is to add animation and venn diagram to implemented application. Another is to be desired that the educational application includes items, for example, contraposition, proof by contradiction and clarity of definition.

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Fig. 1 Screen shot1
of Application

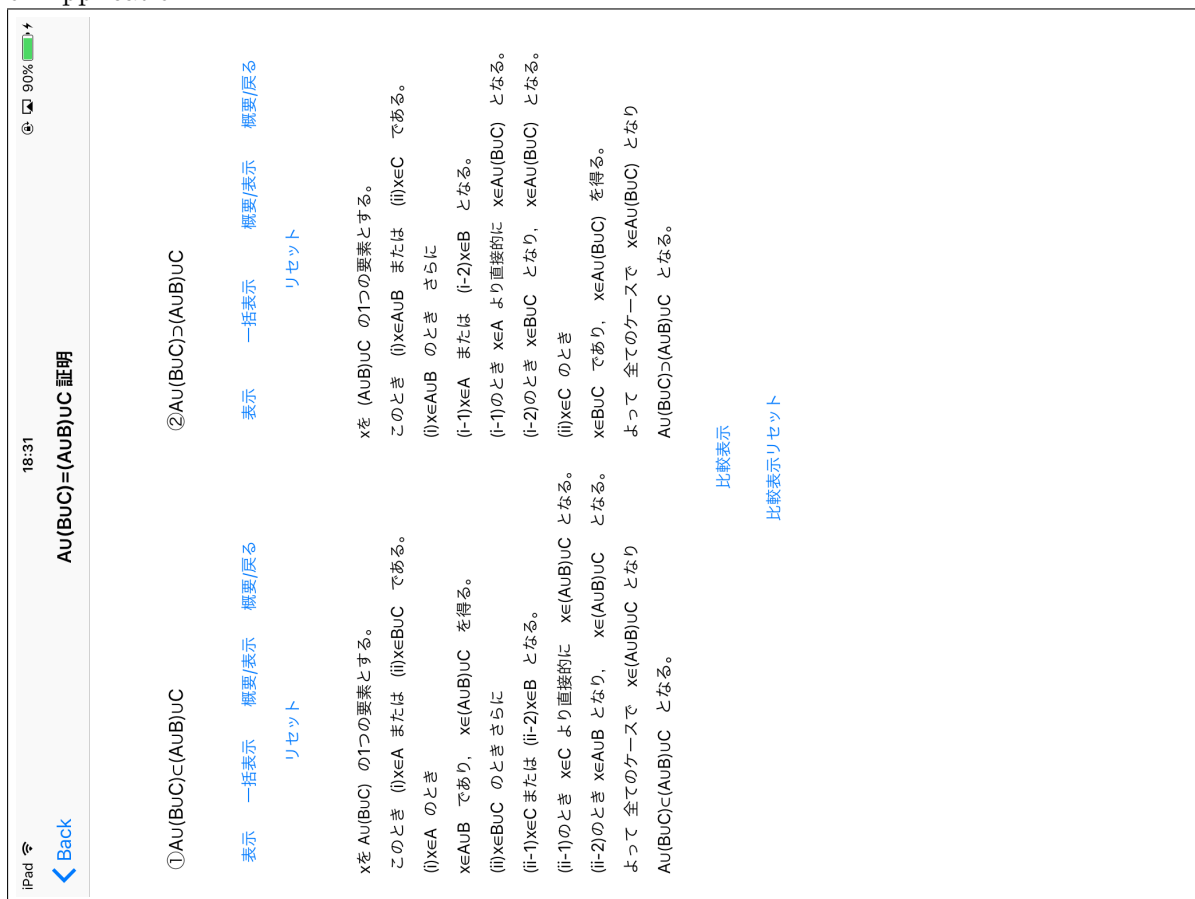


Fig. 2 Screen shot2
of Application



Fig. 3 Screen shot3
of Application



Fig. 4 Screen shot4
of Application



Fig. 5 Screen shot5
of Application



Fig. 6 Screen shot6
of Application