Introductory Education on Information Mathematics using Napier's Binary Chessboard

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Abstract: The "Napier’s binary chessboard" is a calculating board introduced by John Napier in his book "Rabdologiae" [1]. This Napier's binary chessboard can easily be basic four arithmetic operations of binary numbers. In this paper, we propose teaching materials as one of the applications to introductory education on information mathematics using the "Napier’s binary chessboard", and also show the result of the real introductory education using the teaching materials proposed above.

Keywords Napier's chessboard, Introductory education, Information mathematics, Binary numbers.

1. Introduction

The “Napier’s binary chessboard” is a calculating board introduced by John Napier in his book "Rabdologiae" [1]. This Napier’s binary chessboard can easily be basic four arithmetic operations of binary numbers. Maeyama and Takagi explain the features and applications of Napier’s binary chessboard on their paper [2] referring to the topics of “The oldest binary computer” [3].

On the other hand, the difference of academic skills of newly enrolled students at private universities in Japan becomes bigger because of various university entrance examinations in recent years. Therefore, universities are devised as well as pre-admission, also the first year education after admission in many cases. We also have practiced this introductive education for several years such efforts at Kogakuin University. For more precise explanation, see [4] and the corresponding papers [5-6].

In this paper, we propose teaching materials as one of the applications to introductory education on information mathematics using the “Napier’s binary chessboard”, and also show the result of the actual introductory education using the teaching materials proposed above.

2. Napier’s binary chessboard

The “Napier’s binary chessboard” is an interesting tool which tells us the same calculation in binary numbers regarding “put a piece or not” as “1 or 0”.

![Fig.1.  Napier’s binary chessboard](image-url)
3. Introductory education

Here, we propose teaching materials to the introductory education on information mathematics as one of the applications of Napier’s binary chessboard.

(1) What is decimal numbers?
(2) What is binary numbers?
(3) Basic four arithmetic operations of binary numbers
(4) What is the “Napier’s binary chessboard”?
(5) Basic four arithmetic operations of binary numbers using Napier’s binary chessboard
(6) Assignment
(7) Questionnaires

We assume 45 minutes in this lecture. In addition, we prepare handout and MS PowerPoint slides about this lecture.

4. Results

We gave a lecture along with the teaching materials mentioned above to high-school students who wish to enter the department of computer science at Kogakuin University. However, we have just 15 minutes because of achievement test and exchange meetings. We did our best for the lecture.

The results of questionnaires are as follows:

(1) Do you have fun in this lecture?
   Yes: 88%, No: 2%, Other: 10%
(2) Do you feel too long this lecture?
   Yes: 2%, No (too short): 45%, No (best): 53%
(3) Do you understand the contents of this lecture?
   Yes: 95%, No 2%, Other: 3%
(4) Do you want to do assignment?
   Yes: 92%, No: 0%, Other: 8%
(5) Do you think the contents of this lecture help to study after entering to Kogakuin University?
   Yes: 98%, No: 0%, Other: 2%
(6) Are you interested in informatics taking this lecture?
   Yes: 90%, No: 0%, Other 10%
(7) Do you understand easier the teacher’s explanations?
   Yes: 97%, No: 0%, Other: 3%

We also have comments from students as follows:
(a) I want to take lectures at Kogakuin University as soon as possible.
(b) I am interested in binary numbers.
(c) I have studied binary numbers in high-school, but I understand them deeper.
(d) I want to try Napier’s binary chessboard in hexadecimal numbers.
(e) I was boring because I have already known about binary numbers.

5. Conclusion

Beyond the lecture actually, we should consider teaching materials in accordance with the class time. In addition, it is necessary to create opportunities after entering the university to take advantage of the introductory lecture. In this way, to be considered as a series towards the first year education after admission from introductory education leads to motivation for the students. On the other hand, for the faculty members, it is possible to investigate the state of students through the entering the university. It is very effective for both, however time for the introductory education is not ensured almost at present. We shall improve the environment by showing practical examples like this because of the significance of education.

References