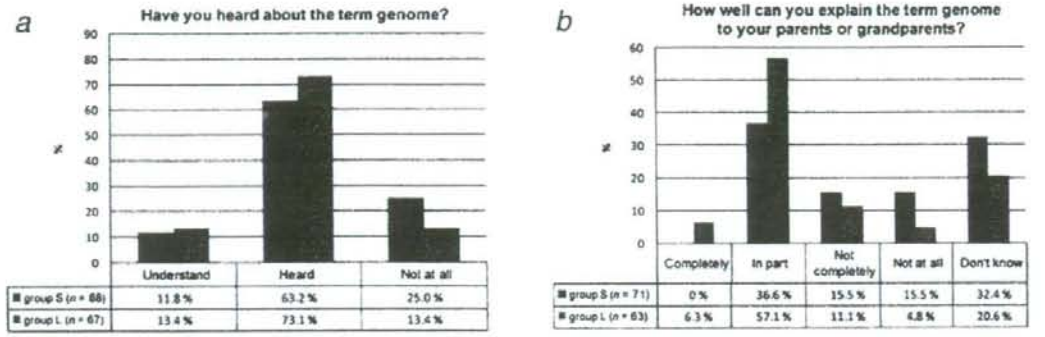

FIG. 2. **Results of the preprogram questionnaire (*a*) and the postprogram questionnaire (*b*) asking how many students considered to understand the term genome.** (*a*) Have you heard about the term genome? (*b*) How well can you explain the term genome to your parents or grandparents?

genome science, we conducted the preprogram and postprogram questionnaires and focus-group interviews.

We statistically analyzed the questionnaire responses for the two groups separately (*i.e.* the short program [group S] and the long program [group L]). The preprogram question asking how much students considered to understand the term genome showed no significant difference between the two groups in understanding the term "genome" before taking part in the program (Fig. 2*a*). The postprogram question asking how well they explained the term genome showed that the number of students who considered that they could explain the genome, in part or completely, in group L (63%) was significantly ($p < 0.05$) higher than those in the group S (37%; Fig. 2*b*). The preprogram survey suggested the equivalence of group S and L, though the preprogram and postprogram questions were not identical. Herein, the postsurvey suggested that some increases in students' understanding of the term genome were observed with longer exposure to the program. In addition, we asked how, after the program, their view of the term genome changed. The results showed that they left the experience with more positive feelings towards the term genome than negative ones (Fig. 3).

About 10 months after the program, we conducted the two focus-group interviews. From the viewpoint of the educational capacity of the teaching program as an introduction to genome science, summaries with select, representative comments are provided here.

Six of 24 interviewees mentioned that their motivation for learning increased when they found the content beneficial and relevant to themselves: "I am motivated to learn when the topics are worth learning (1D, representing member D of group 1)."

Seven of 24 interviewees mentioned that they became interested in the Nagahama project, a large cohort study carried out in their local community. Of the seven, five mentioned that they explained it to their family members: "After the teaching program I watched news on the Nagahama Project and talked about it with my family (2N)." This suggested that a local and medical topic like the Nagahama project attracted their interest so as to talk about it with their family members. In addition, two interviewees mentioned that they were impressed by the

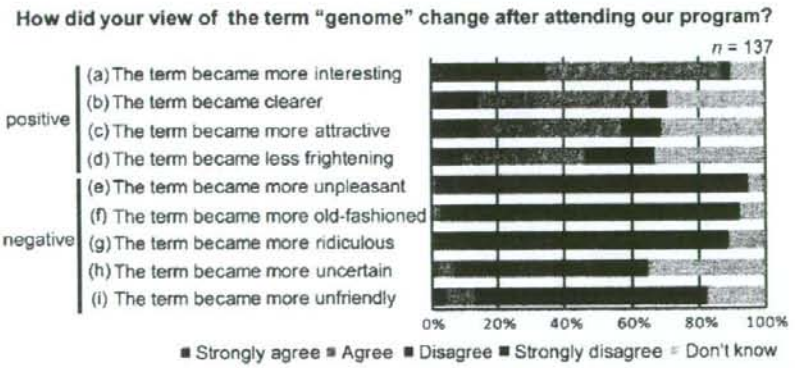

FIG. 3. **Results of the postprogram questionnaire asking how the students' view of the term genome changed after attending the program.** [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

fact that 99.9% of the genome is the same among individuals: "The fact that 99.9% of the genome is the same was very impressive, so I remember the fact (2D)." This suggested that students felt the topics related to them were worth learning. As a result, 6 of 24 interviewees mentioned that their familiarity with the genome science was sustained 10 months later: "I am now more familiar with the term genome than before (1E)."

In this way, we thought that learning about the human genome is a good way to introduce students to genome science because the human genome has relevance to their daily lives and themselves.

Altogether, these data showed that students felt that they learned about genome science from the program with positive feelings because they found the topics relating to the human genome beneficial and relevant to themselves.

Subjective Perceptions on the Educational Value of the Multimedia Presentations

Illustrations have been used since ancient times and carefully designed, and appropriate illustrations have proved to be beneficial for conveying complex systems. On the other hand, animations are new tools and they are thought to possibly communicate more effectively than illustrations in situations for continuous changes, although their efficacy has not been fully established [18]. Indeed, some literature reported the efficacy of animations on continuous biological processes [11–14]. Considering these findings, we decided to juxtapose the illustrations with animations.

We then tried to assess the perception of students about the potential of multimedia presentations from the preprogram and postprogram surveys and the focus-group interviews.

The major difference between the short and long program is the quantities of multimedia presentations used (Table II). The long program had a quiz that the short program did not have, but we thought the addition of Quiz 2 had little influence on the students' understanding of the term genome because the answer of Quiz 2 had already been shown in Animation 1. As described previously, the pre- and postprogram surveys gave a suggestion that the long program worked more effectively than the short program in terms of students' considering to understand the genome. This suggested that our mixed multimedia presentations may have worked.

In the focus-group interview, five students positively responded to animations: "They described the unseen, so they allowed me to imagine the event more easily... they made the lecture more enjoyable than the traditional lectures (1A)."

On the other hand, eight students positively responded to the human genome map poster: "The human genome map poster helped me deeply understand the relationship between the chromosome and the gene although the traditional lecture couldn't (2K)."

These results suggest that students may have preferred either the poster or animations. The information included in the animations and the poster was redundant, although they were not completely identical. Therefore, these results implied that our mixed multimedia presentations may have had an effect of repeating important points in the same program. To investigate the roles of the poster and animations, we needed more controlled experiments.

Promoting a Better Understanding of the Large Cohort Study

Our teaching program had an aspect of promoting a better understanding of the Nagahama project. To assess this aspect, we statistically analyzed the preprogram and postprogram questionnaire responses. The preprogram question asking how many students considered to understand the Nagahama project showed that the number of students who did not consider to understand at all were very high in both group S and group L; in particular, group L (87%) were significantly higher than group S (65%; Fig. 4*a*). The postprogram question asking how well the students considered they could explain the Nagahama project showed that the number of students who answered "not at all" or "don't

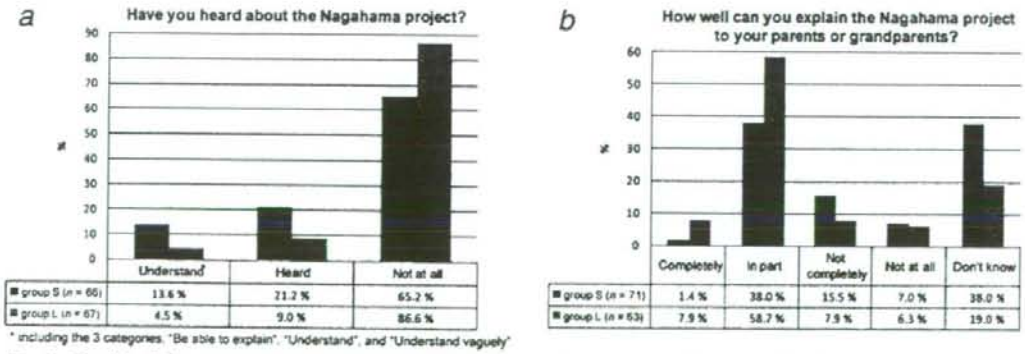

FIG. 4. **Results of the preprogram questionnaire (*a*) and the postprogram questionnaire (*b*) asking how many students considered to understand the Nagahama project.** (*a*) Have you heard about the Nagahama project? (*b*) How well can you explain the Nagahama project to your parents or grandparents?

know" in group L (26%) was significantly ($p < 0.05$) lower than the rate of those in the group S (45%; Fig. 4*b*). These data showed that the teaching program decreased the number of students who did not understand the Nagahama project with longer exposure to the program.

Recommendation for an Additive Teaching Program

Seven students' comments on the demand of the successive teaching program were obtained from focus-group interviews: "I had a lot of trouble learning from just one program, so I think it's good to implement the program several times so as to understand it deeply (1D)."

Although we could not determine which contents students thought may be included in the additive program from the interviews, we think that in addition to the consecutive implementation of the program, it may be helpful to implement hands-on laboratory activities [19]. The SNP genotyping of the *ALDH2* gene explained in our animation 7 may be a good example, particularly because the kits for education of SNP genotyping of the *ALDH2* gene are commercially available (DNA Chip Research, Kanagawa, Japan).

FINAL REMARKS

In conclusion, our teaching program which included two types of multimedia presentations could achieve our goal—introducing students to genome science—in that students felt that they learned about the human genome from the program and some increases in students' understanding of the term genome were observed with longer exposure to the mixed multimedia presentation. In addition, the teaching program also could support the large cohort study, the Nagahama project, in that some increases in students' understanding of the project were observed.

The potentials of these multimedia presentations need to be examined more carefully using more controlled experiments. The poster and animations are now available in English. Therefore, they can be utilized by instructors around the world.

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