

## **2dc – A Web-based 2-dimensional Student Response System for Real-time Feedback in Classrooms**

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**Abstract:** We developed a 2-dimensional student response system (clicker). Students click on any point on a 2-dimensional plane using web browsers of their smartphones or PCs, and teachers can see all the positions where each student clicks on in real time. With the tool, you can get the answers for two items from students at the same time, which means you can see the correlation between those items in real time. Furthermore, it is possible to ask students to answer in continuous values, and also to see the pre-post change in the animation. The tool has been made possible with techniques like HTML5, WebSocket, and D3.js.

**Key words:** clicker, realtime feedback, visualization, HTML5, WebSocket, D3.js

### **INTRODUCTION**

Although it is effective to use a clicker (i.e., a student response system) as a tool to investigate thoughts or to obtain answers from the learners during the lecture in real time, generally it has limitations that the learners can only choose about ten options by pushing the buttons, and also teachers need the dedicated software for viewing the results.

In this paper, we introduce a two-dimensional clicker named ‘2dc’ with which you can see each answer from all the learners at a glance in real time by letting them to click on a two-dimensional plane in the screen of their own smartphones or PCs.

### **DESIGN AND CONFIGURATION OF THE TOOL**

The tool ‘2dc’ (Kita 2015) is designed to be run basically on the server machine on the internet as shown in Fig. 1.

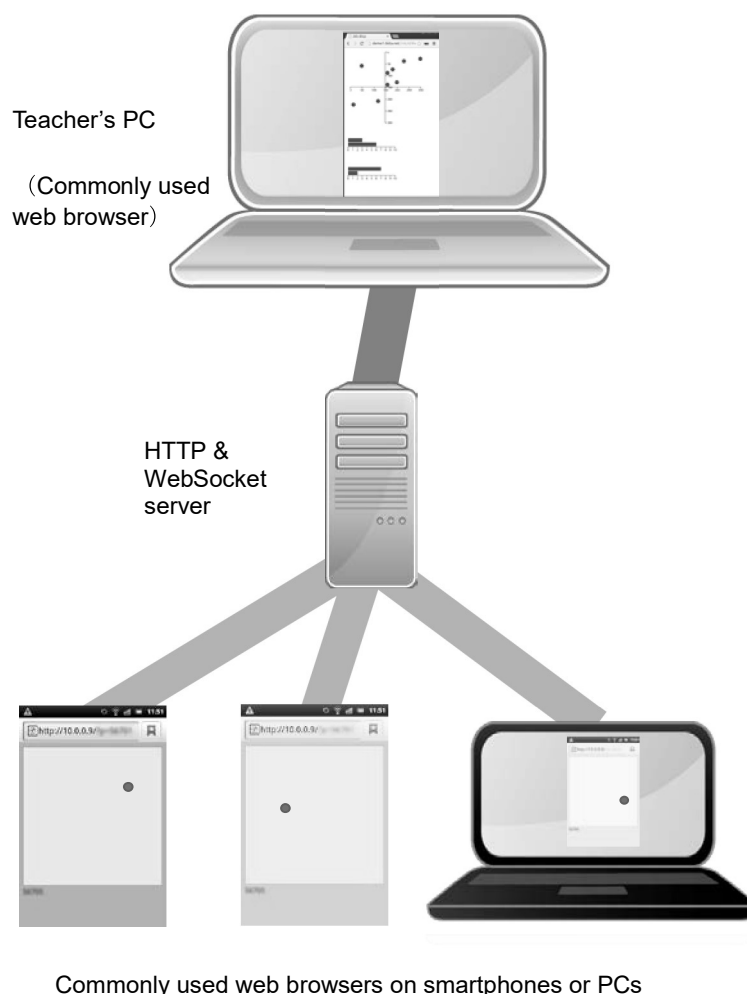


Fig. 1. Configuration overview of the tool '2dc'

On the server machine, two different servers (daemon processes) are running. One is the HTTP server for collecting information transmitted from web browsers running on the student's smartphones or PCs. Another server is WebSocket server (Chamling 2013, Mugimugi 2014) for aggregating the information sent from the HTTP server to transmit in real time to the teacher's screen (a web browser) in WebSocket protocol (Wikipedia 2016).

When students visit the specified URI by web browsers on their smartphones or PCs, they see the screens as shown at the bottom of Fig. 1 on the web browsers, where they can click (or touch) at any position in the rectangular area. The x-y positions of the clicked points in the area are detected using HTML5 Canvas element.

The values of width and height attributes of the Canvas element are fixed to 300px so that the return values of x and y coordinates of the clicked points take values from 0 to 300 regardless of the size of the device screen.

In addition, to avoid unstable operation caused by unintended pinching in or out on the screen, the HTML parameter values of the screen page were set as follows:

```
<meta name = "viewport" content = "width = device-width, initial-scale = 1.0, maximum-scale = 1.0, user-scalable = no"/>
```

The aggregated results that are displayed on the teacher's screen is visualized using D3.js (D3.js 2016) as shown in Fig. 2.

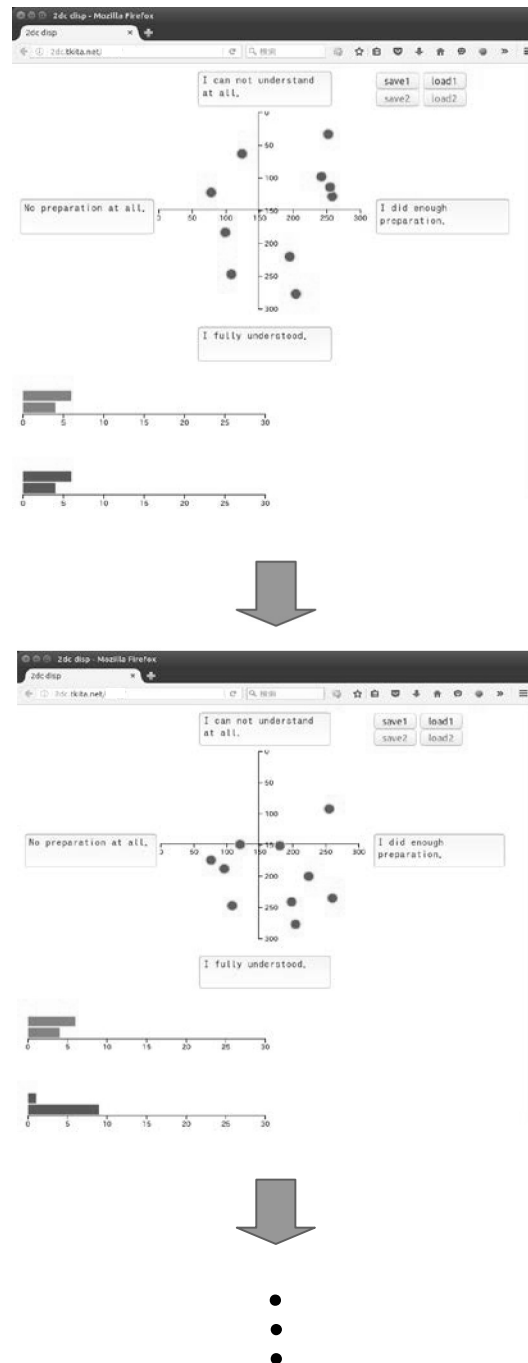


Fig. 2. Example of a monitor screen (teacher's screen) updated in real-time

A teacher can see where each of the students clicked on the two-dimensional plane at a glance. In addition, the number of students who chose (by clicking) each area (such as left half, or right half) of the two-dimensional plane is calculated and shown in bar graphs. This monitor screen is updated in real time each time the students click on the screen of their own devices.

The tool has 'save' and 'load' functions available for teachers. 'Save' function is to store the positions of points at a certain time. 'Load' function enables teachers to restore the positions of all the points according to the stored data. Teachers can store 2 sets of data (that indicate 2 different situations) which is useful for them to see the difference between pre- and post-lecture, or to see the change before some learning activity and after it.

## APPLICATION EXAMPLES

By this tool, 2dc, you can get answers to two questions (items) at the same time, so you can see the correlation between the two items in real time. It is possible to ask answers in continuous values, rather than such as "Yes / No", or in 5 levels. It is also possible to see pre-post changes in animated image.

Utilizing those features, there are several possible applications of the tool for surveys during class such as:

(1) At the time when the first half of the lecture time passed, the teacher lets each of the students to answer the questions like "Did you do sufficient preparation for this class this time?" (left edge: No preparation at all, right edge: I did enough preparation) and "Did you understand the lecture so far?" (top: I can not understand at all, bottom: I fully understood), by clicking on the corresponding point on the two-dimensional plane.

(2) The teacher gives the question like "If we let the radius of the earth 1, how much is the radius of the moon and the radius of Mars?" and lets each student click on the radius of the moon (left edge for 0, center for 1, right edge for 2), the radius of Mars (top for 0, center for 1, bottom for 2).

(3) At the beginning of the class "Artificial Intelligence and the human society", the students are asked to answer questions of "Does AI do harm to human beings?" and "Is AI totally helpful to humans?" by clicking. At the end of the class they answer the same questions, and the teacher checks the results together with students to see how much their impressions changed.

## CONCLUSION

'2dc' is a very handy tool for a teacher to get feedback from the learners in real time. It is usable with various devices like smartphones, tablets and PCs without any special preparations in advance as long as the internet connection is available.

This tool is to be publicly released online (Kita 2016).

## ACKNOWLEDGEMENT

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## REFERENCES

- [illegible]