Einstein Robot Teaching Math (Technical Report)

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Abstract

We conducted experiments on robotics among a total of 76m students in two rural schools in China. The content of the teaching included symbolistic representation and simple equations. The students were equally divided into a group teaching with robot (VyesR) and a group without robot (VnoR) in advance, with an about equal number of boys and girls, and about equal division of math skills as indicated by their teachers. The only difference between two kinds of groups was whether having robot standing next to the instructional video and performing simple animation. Those students are from fourth grade and have little knowledge about simple equations (baseline 0). Students should watch the 8-minutes instructional video with or without robot, and then fill in the Likert evaluation and test paper. Likert evaluation was on video and robot (if had), and test paper contained two symbolic representations and six simple equations to solve (eg. 3y=9). Afterwards, we found all students achieved over 50% gain from baseline zero in solving equations, in which boys in VnoR gained 18% more than those in VyesR (70% and 52% respectively), while girls in VyesR gained 20% more those in VnoR (71% and 51% respectively). Conclusion was made that students can learn both from the video and robot, but girls benefit more from robot teaching, while boys benefit more from video. Results are discussed that gender difference must be taken into account in robot teaching promotion.

Abbreviation List

VyesR	Video with robot (group with robot)
VnoR	Video without robot (group without robot)
NanXing	Nanxing primary school
BoMei	Bomei primary school
SymR	Score of correct symbolic representation
%EqC	Percentage of correct equations
App-r	Appreciation for robot
App-v	Appreciation for video

Experimental Plan

Hypothesis

Based on the previous studies, we formulated two hypotheses: Our first hypothesis is that a robot teaching new contents increases the learning outcomes compared to baseline (H1); 2) While being instructed through video, the addition of a robot will motivate children more than video alone (H2)

Participants

we have two set of fourth grade students from Nanxing primary school (NanXing) and Bomei Secondary Primary School (BoMei). The experiment was conducted independently in two school separately.

NanXing primary school is in Meitang Town, Puning City and Bomei Secondary primary school is in Bomei Town, Lufeng city. Both are countryside-level cities and defined as third-tier ones, and they are sharing the similar educational equipment and never exposed in high technology. They are satisfied the first requirement of participant we want to find, who are in rural country and know little about the robotics.

Besides, they have the resemble language (whose mother language is Teochew dialect and teaching language is Mandarin) and culture. So it can be confirmed that they do not have language barrier during the experiment. The students from these two schools have similar family financial condition and most of them are taken care by their grandparents resulted from their parents working out of the towns. In general, grandparents do not focus much on academic performance, therefore students do not have excessive pressure on learning, which discouraging them to learn the knowledge in advance. This makes them meet the requirement that participant should have zero baseline towards the knowledge in the experiment.

We consulted some experienced teachers about what grade students are suitable for the experiment. We found the students below grade two might be too young to focus on the experiment and those higher than four grade might too mature to psychologically accept what the experiment displays. In the table I, you can find the gender and group distribution of these two schools.

School & RoboYN	Nanxing		Bomei	
	VnoR	VyesR	VnoR	VyesR
Female	8	8	11	8
Male	7	8	11	12
Missing	2	1	0	0
Total	17	17	22	20

Table 1: School, gender and group distribution

Materials

we prepare a simple robot from Hanson Robotics called Professor Einstein, an 8-minute Chinese spoken video instruction, test paper and appreciation rating scale.

Hanson's Professor Einstein is a 15-inch robot with impressive and expressive facial features (Figure 1). Its arms move and one of its hands has an articulated finger that can point. The

Professor's feet have wheels to have a walk. Einstein has a microphone and a camera that supposedly help it to look at people when they talk to him. The robot has two voice, a kind of narrator that sound like young man and gives you instructions, and Einstein's voice that sound like old man and gives you response. The volume of the voice cannot be controlled. The Professor has three modes: an offline, online, and mobile mode. When Einstein's online, everything you say to it gets processed in the cloud, and you should wait a few seconds for the robot to answer you back. Only the questions began with "Who is" or "What is" can successfully get response from the robot. In offline mode, you can "chat" with the professor and ask it to do things, like smile, stick out his tongue, talk a walk, or go crazy. Mobile mode connected the Professor directly to the app for playing games and taking quizzes through the supplementary application called Stein-O-Matic on the tablet, or to the laptop to play the animation the you pre-set on the Scratch-X. It fits the experiment setting as a very simple robot. During the experiment, the robot pretended as a teacher by playing corresponding animation and as speaker source.

Figure 1. Professor Einstein

An 8-minute Chinese spoken video instruction teaches symbolic representation and simple equation solving. Symbolic representation is the base of the simple equation. Only knowing the symbol, like letter and shape, can represent a number do they understand the meaning of equation. In the first two and half minutes of the video, the students will learn use *y* to represent the unknown quantity of a bag of apple and how to simplify the expression from, for example, 3+*y*+*y* to 3+2*y* (Figure 2). During the next one minute of the video, students will learn the meaning of equation as balanced scales (Figure 3), and in the rest time the video will use three example (*y*+2 =5, *y*-2=3, *y*+*y* =6) to demonstrate the equation solving (Figure 4). Solving simple equations is taught in the first semester of fifth grade. Combined with the learning culture we mentioned above, we were certain that the teaching content is totally new to the students. The video was recorded in old man sound pretending it was the voice of the Einstein robot.

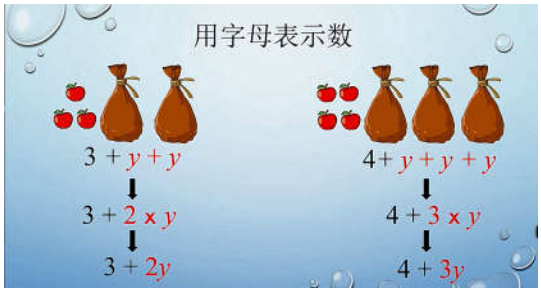

Figure 2. Represent the number with formal symbols

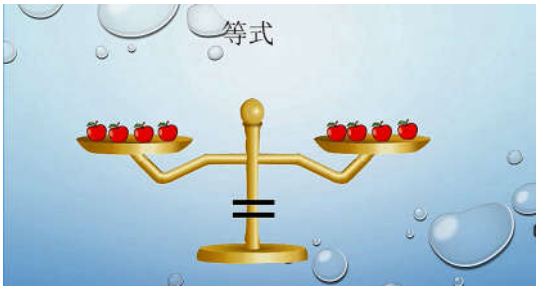

Figure 3. The meaning of equation

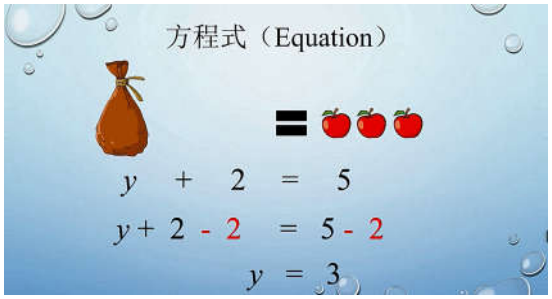

Figure 4. Simple equation solving

Test paper is to test the students' learning outcome, consisting two items on symbolic representation and six items on simple equations. Each symbolic representation item shows a number of apples and bags and children are asked to translate the picture into formal symbols. The correct answers to items of symbolic representation in Figure 5 would be 5+*y* and 4+2*y*. The correct answers to items of simple equation sequentially would be 1, 8, 2, 2, 3 and 4.

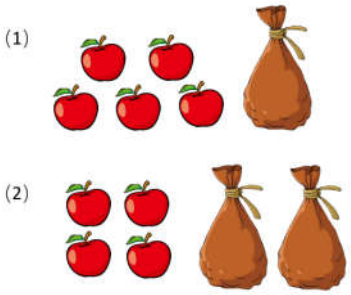

Figure 5. Items of symbolic representation

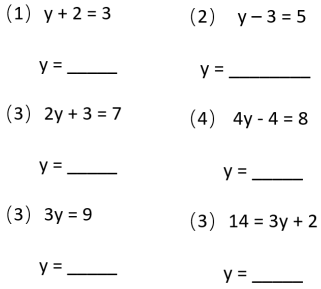

Figure 6. Items of simple equation solving

For the appreciation rating scale, there are two versions for the groups with robot and the groups without the robot. The version for the groups with robot consists of two single-item rating scale for appreciation for video and robot. And the version for the groups without the robot only has one single-item rating scale for appreciation for the video. Figure 7 and Figure 8 depict the rating scales.

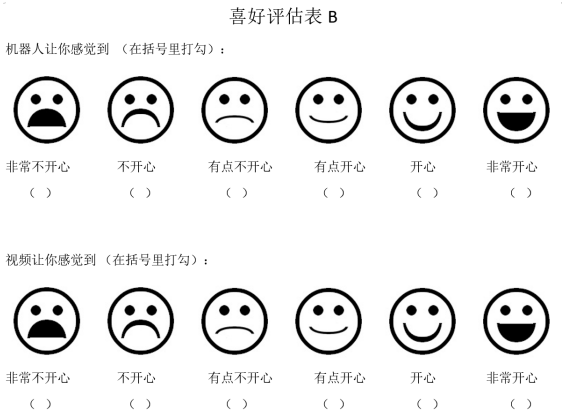

Figure 7. Appreciation rating scale for group with robot

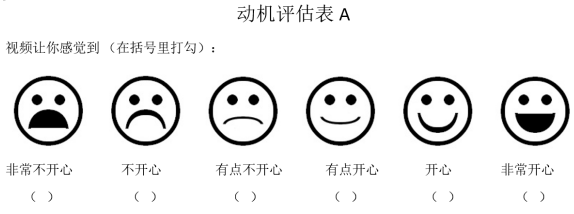

Figure 8. Appreciation rating scale for the group without robot

A piece of appreciation rating scale, a draft paper and a copy of test paper are clipped to a clipboard from top to bottom, and children are asked not to turn to the next page before they

finish the top one. In this case, children would not add the influence of test paper for them to their appreciation for solely lecture experience.

Procedure

Nanxing primary school and Bomei primary school provided us a bit different experiment supporting. According to the conditions, group division, experiment environment setting, and the order of execution were made a corresponding adjustment between these two school.

Here we go to the group division. Our initial number of each group was less or around 15 children in order to well maintain discipline during experiment and ensure children have clear view to robot and video. In Nanxing primary school, there are total 34 fourth grade students took part in our experiment, they were divided into two group and each group had 17 children. However, there were totally 42 children in Bomei primary school. To control the number, we divided them into four groups, two of which are groups with robot and the rest are group without robots.

We conducted the experiment in Nanxing primary school on weekdays when they could not provide us two standardized classrooms, so we made use of the music room as experiment room and multimedia room as buffer room which were opposite to each other. The Figure 9 and Figure 10 depicts the environmental map and photo in Nanxing primary school.

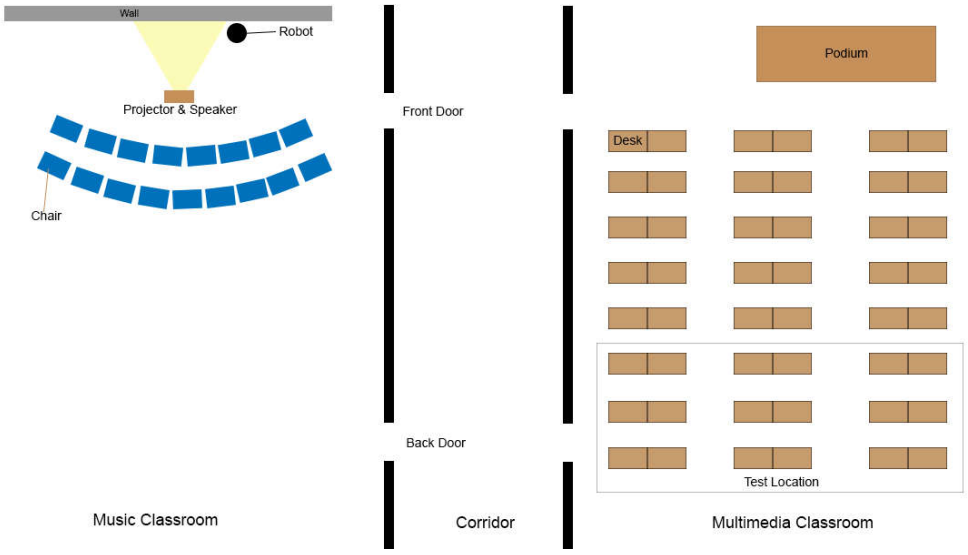

Figure 9. Environmental map in Nanxing primary school

Figure 10. Photo of the experiment room in Nanxing primary school

The Bomei primary school permitted us to conduct our experiment on Saturday and supplied us three standardized classrooms which we could reset. The Figure 11 shows the environmental setting in Bomei primary school. The right classroom was for the group with robot (Room A) and the left one was for group without the robot (Room B). The only difference between them was without having the table, on which standing the robot, on the left front of the portable screen. Figure 12 is the live photo during the experiment on the group with robot in Bomei primary school.

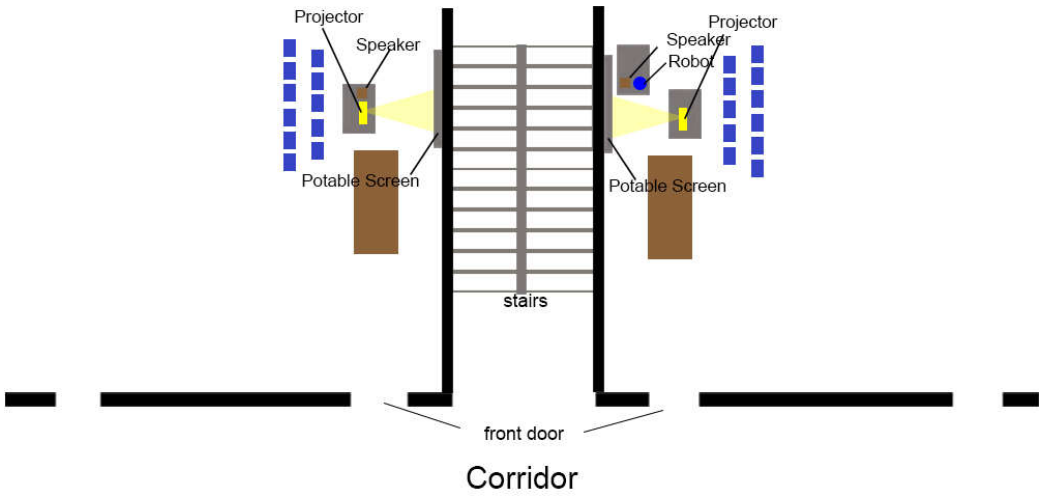

Figure 11. Environmental map in Bomei primary school

Figure 12. Live photo of the experiment in Bomei primary school

Then we designed the order of experiment execution in two school. Nanxing primary school could only gave us 45 minutes to perform the experiment, combining that we only had one experiment classroom (Figure 9), we made the experiment run half-serially. Table 2 is the experiment implementation timetable in Nanxing primary school.

26th March, 2018		
Time	Group without robot (VnoR)	Group with robot (VyesR)
14:30	Students gathered in their own classroom. They were told (1) firstly they would see an 8-minute video; (2) after video instruction they need to do the appreciation rating scale and test paper	
14:35	Remained in their classroom	Brought to the music classroom
14:40		Had the video instruction with robot
14:48	Began to setting off to the music classroom	Brought to the multimedia classroom
14:50	Had the video instruction with robot	Do the test paper and the appreciation rating scales
14:55		Collecting test papers and the appreciation rating scales
15:00	Did the test paper and appreciation rating scales	Waited in the multimedia classroom
15:05	Were collected test papers and the appreciation rating scales	
15:10	All groups and instructors gather in the music classroom, interacting with the robot	

Table 2. Implementation timetable in Nanxing primary school

As we mentioned before, there were four groups in Bomei primary school and two experiment rooms. We divided the groups into two sections, each of which has a group with robot and a

group without robot. The two sections performed the experiment serially and two groups in a section run parallel. Table 3 depicts the implementation timetable in Bomei primary school.

<table>
<tr><td colspan="5">5th May, 2018</td></tr>
<tr><td rowspan="2">Timeslot</td><td colspan="2">Section 1</td><td colspan="2">Section 2</td></tr>
<tr><td>VyesR</td><td>VnoR</td><td>VyesR</td><td>VnoR</td></tr>
<tr><td>14:25 –14:35</td><td colspan="4">Students gathered in their own classroom. They were told (1) firstly they would see an 8-minute video; (2) after video instruction they need to do the appreciation rating scale and test paper</td></tr>
<tr><td>14:40 – 14:50</td><td>• Watched video
• Filled out the appreciation rating scales
• Did the test paper (in Room A)</td><td>• Watched video
• Filled out the appreciation rating scales
• Did the test paper (in Room B)</td><td colspan="2">Waited in their own classroom</td></tr>
<tr><td>14:50 – 14:55</td><td colspan="2"></td><td colspan="2">Lined up to go to the experimental rooms</td></tr>
<tr><td>14:55 – 15:00</td><td colspan="2">Lined up to go back to the classroom</td><td colspan="2">Prepared for the experiment</td></tr>
<tr><td>15:00 – 15:15</td><td colspan="2">Waited in their own classroom</td><td>• Watched video
• Filled out the appreciation rating scales
• Did the test papers (in Room A)</td><td>• Watched video
• Filled out the appreciation rating scales
• Did the test papers (in Room B)</td></tr>
<tr><td>15:15 – 15:45</td><td colspan="4">Interaction with the robot in the classroom</td></tr>
</table>

Table 3. Implementation timetable in Bomei primary school

To summarize, none of the students were informed about the presence of the robot, and they were informed before the experiment that they would watch the video instruction and later did an appreciation rating scale. Then the group would take turn to the corresponding experiment room to participant the experiment. They firstly watch the video instruction, and then the research assistants would distribute them the clipboard (refer to ***Materials***) to further the test paper and appreciation rating scale. After finished all the task, the paper materials would be collected by the research assistant and scored.

During the whole experiment, children were not allowed to chat with classmates or research assistants to avoid peer influence and assistant preference influence on the experiment result. Though the two groups in Nanxing primary school (Table 2) would see the another group at classroom exchange around 14:48, we make the previous group move from the front door and the latter group came in through the back door without any chatting. It is the same in Bomei primary school where there was a crossed time when two sections of children exchange their position. To avoid the information of robot was leaked, we required the group with robot in first section to keep it as secret what happening in the classroom and promised that they would get reward if they made it. In fact, after we interviewed the groups in the second section afterward, we found they did not know the presence of the robot. So we could say, the groups are all independent and at the same beginning status.

Equipment

In the groups with robot, they had the robot pretending as teacher by playing simple animation, like turning its head and blinking its eyes, and being speaker source. To successfully play the animation, the Einstein robot should be set on mobile mode and controlled by the experiment assistant through the computer. But before the experiment in Nanxing primary school, the robot was found could not work well in mobile mode, so we turned it to online mode. It could maintain power on in eight minutes and turned its head and blinked its eyes since there were sound (from speaker) around it. The imperfection was that it would say something (like encourage asking it questions) spontaneously and played pointing animation during speaking. We placed some transparent tape on its built-in speaker trying to slow down the irrelevant sound, but the sound still could be heard. While in the Bomei primary school, it could work well in mobile mode so we set it that mode. In the table 4, it could be found the status and information of the equipment we used during the experiment.

School	NanXing primary school		Bomei primary school	
Group	Group with robot (VyesR)	Group without robot (VnoR)	Groups with robot (VyesR)	Groups without robot (VnoR)
Laptop (video playing)	Intel-i5	Intel-i5	Intel-i7	Intel-i3
Laptop (robot controlling)	/	/	Intel-i5	/
Robot	Online mode	/	Mobile mode	/
Projector	36.1 (diagonal)	36.1 (diagonal)	36.1 (diagonal)	36.1 (diagonal)
Speaker	√	√	√	√

Table 4. Equipment information

Measurement

The test paper was used to measure whether they got the information the video instruction taught them rather than judge whether their answer was correct. So except the standardized answer to mention above (***Materials***), the answer of symbolic representation items with the extra information and the answer which did not be simplified will be judged as getting a point. For example, a child's answer for the first item (whose standardized answer should be 5+y) in symbolic representation was *5+y=10 y=5* and we could find the *=10 y=5* was the extra information. We marked it correct because the student really learns something from the video tough she or he did not master it well. Taking the time (only 8 minutes) of lecture instructing a new mathematic knowledge as consideration, the unfamiliar was understandable. So the child giving *14-2÷3* as the answer of, for example, the sixth item in simple equation (14 = 3y+2) should be judged having learnt something from the video. The children learn from the video that the y should be got through simultaneously subtracting 2 and dividing by 3 for both sides of the equation though he or she forgot or did not know how to use brackets to declare the calculation priority. And bracket was not mentioned in the video instruction. For the appreciation rating scale, the items from left to right represents 1 to 6 points.

Data Analysis

Overview

The data was collected from the children' test paper and appreciation rating scale (Figure 13). The column with title *School* has two options, which are NanXing and BoMei. NanXing represents the Nanxing primary school and BoMei represents Bomei primary school. It used to differentiate the school the children are from. The column *RoboYN* is to recognize which group the children are in. They are from either VyesR (group with robot) or VnoR (group without robot). The data from *Gender* column are afterward added according to their names and confirmation from their head teachers. The columns with the main title *Test paper* included the raw data in their test papers and scores of symbolic representation items and simple equation items. The columns with subtitle in the format of *Ans number1 (number2)* recorded the initial answer the children gave. *number 1* is index of test paper, representing two question types – 1 is symbolic representation and 2 is simple equation. The second number in brackets marked the sub-index of their own question group.

According to the rating method explained in ***Measurement*** in last section, we marked the cell as red which was seen as the subject had learnt from the video instruction. In column with subtitle *SymR*, we add up the number of previous two red cell. It would be 0, 1 and 2. Among the children, four of them skipped the both items of symbolic representation, so we marked their total scores as N/D. The column with subtitle %EqC calculated the percentage of correctly solved equations. For those who solve more than one to six, we took that as hundred percent. So those people, for example, who solve five and missed one will still be considered full score. There were seven children skipped one slot and two person skipped two and three separately. Only a child who did not fill out one of the equation would not be included in the analysis of the percentage correct and marked as N/D. The Table 5 depicts the distribution of missing slot in test paper.

School & RoboYN	**NanXing**				**BoMei**			
	VnoR		**VyesR**		**VnoR**		**VyesR**	
Number of Missing slot	SymR	%EqC	SymR	%EqC	SymR	%EqC	SymR	%EqC
0	15	15	16	13	22	21	19	17
1	0	1	0	3	0	1	0	2
2	2	0	1	1	0	0	1	0
3		0		0		0		1
6		1		0		0		0

Table 5. Distribution of missing slot

For the appreciation for robot and video, we marked them in the column with subtitle *App-r* and *App-v* respectively. The groups without the robot (VnoR) would skipped the rating for the robot, and you could see the blank cell in the corresponding location. There was one child in the group without robot (VnoR) did not fill out the evaluation for the video and we took it as N/D.

School	RoboYN	Gender	Test paper										Motivation score sheet	
			Ans 1 (1)	Ans 1 (2)	SymR	Ans 2 (1)	Ans2 (2)	Ans 2 (3)	Ans 2 (4)	Ans2 (5)	Ans 2 (6)	%EqC	App-r	App-v
NanXing	VnoR	Female	5=y	4=y	0							N/D		3
NanXing	VnoR	Female	5=y	4=y+y	0	2+3	5-3	3+7	8-4	3	14÷3	0.00%		5
NanXing	VnoR	Female	y=5	y2=4	0	2	3	2	4	3	3	33.33%		5
NanXing	VnoR	Male	5+y=8	4+2y=12	2	1	8	2	4	3	4	83.33%		3
NanXing	VnoR	Male			N/D	1	8	2	3	3	4	100.00%		6
NanXing	VnoR	Male	8	10	0	1	8	4	4	6	1y	33.33%		6
NanXing	VnoR	Male	5+y=8	4+2y=10	2	1	8	2	1	3	4	83.33%		6
NanXing	VnoR	Male	y+5 =8	2y+4 =12	2	1	8	2	12	3	4	83.33%		6
NanXing	VnoR	Female	5=y	4=y+y	0	2+3	5-3	7+3	8-4	9-3	2+3	0.00%		5
NanXing	VnoR	Female	5=y	4=y+y	0	2+3	3-5	3+7	8-4	9-3	y+2	0.00%		5
NanXing	VnoR	Female	y=5	2y=4	0	5	8	10	3		5	40.00%		5
NanXing	VnoR	Male			N/D	1	8	2	4	3	4	83.33%		4
NanXing	VnoR	Male	5+y=5y	4+2y =42y	2	1	8	2	3	3	4	100.00%		4
NanXing	VnoR	Male	5+y	4+2y	2	1	8	2	3	3	4	100.00%		6
NanXing	VnoR	Male	5+y	4+2y	2	1	8	2	3	3	4	100.00%		6
NanXing	VnoR	Female	y=5	2y=4	0	1	8	2	1	3	3	66.67%		3
NanXing	VnoR	Female	y=5	y=2	0	1	8	2	1	3	4	83.33%		3
NanXing	VyesR	Male	y=5	2y=4	0	1	8	2	3	3	4	100.00%	5	4
NanXing	VyesR	Male	5=2y	4=2y	0	1	8	2	3	3		100.00%	4	4
NanXing	VyesR	Male	5=1y	4=2y	0	1	8	2	3	3	4	100.00%	3	4
NanXing	VyesR	Male	5 y	4 2y	0	1	8	2	3	3	4	100.00%	5	5
NanXing	VyesR	Male	5y	5y	0	1	8	2	3	6	9	66.67%	6	4
NanXing	VyesR	Female	5+y	4+y+y	2	1	8	2	3	3		100.00%	5	4
NanXing	VyesR	Female	5+y	4+y+y	2	1	8	2	3	3		100.00%	6	5
NanXing	VyesR	Male			N/D	5	2	10	4	9	5	0.00%	6	6
NanXing	VyesR	Male	5+y	4+y+x	1	5	2	10	4	9	2	0.00%	6	6
NanXing	VyesR	Male	5+y	4+y+y	2	5	2	10	4	9	5	0.00%	6	6
NanXing	VyesR	Female	5+y	4+y+y	2	1	8	2	3	3	4	100.00%	6	6
NanXing	VyesR	Male	y−5	y−2	0	1	2	2	4	3	9	50.00%	6	4
NanXing	VyesR	Female	y=5	2y=4	0			5y	4y	6y	5y	0.00%	4	4
NanXing	VyesR	Female	5+y	4+y+y	2	1	8	2	1	3	4	83.33%	6	5
NanXing	VyesR	Female	5+y	4+y+y	2	1	8	2	1	3	4	83.33%	5	6
NanXing	VyesR	Female	5+2y	x 4=2y	0	1	8	2	3	3		83.33%	6	5
NanXing	VyesR	Female	5=5	y+y=8	0	1	8	2	3	3	4	100.00%	6	2
BoMei	VnoR	Female	5+y=10 y=5	2y =4 2y:2 = 4:2=2 4×2=8	1	1	8	2	12	3	4	83.33%		5
BoMei	VnoR	Female	5+y=10 y=5	4+2y=8 y=2	2	1	8	2	12	3	4	83.33%		5
BoMei	VnoR	Female	5+y=10 y=5	4+2y=8 y=2	2	1	8	4	12	3	12	50.00%		4
BoMei	VnoR	Female	5+y=10 y=5	4+y=8 y=2	1	1	8	4	12	3	4	66.67%		4
BoMei	VnoR	Female	5+y =10 y=5		1	1	8	2	12	3	4	83.33%		6
BoMei	VnoR	Female	5+y=8	4+y+y =10	2	3	8	6	12	9	14	16.67%		4
BoMei	VnoR	Male	5+y−8	4+y+y−10	2	1	8	4	12	9	12	33.33%		6
BoMei	VnoR	Male	5+y	4+y×2	2	1	8	4	12	9	12	33.33%		6
BoMei	VnoR	Male	5+y=8	4+y×2	2	3	8	4	12	3	4	50.00%		4
BoMei	VnoR	Female	5+y×1	4+y×2	2	3	2	2	4	9	9	16.67%		N/D
BoMei	VnoR	Male	5+y =8	4+y×2	2	1	2	2	4	3	4	66.67%		4
BoMei	VnoR	Female	y=5 5+5=10	y=4 4+4+4=12	0	3 2	3+5	7 3÷2	4+8÷4	9÷3	14 2÷3	100.00%		5
BoMei	VnoR	Male	y+5=5x	4y+2y=2	1	3-2	3+5	7-3÷2	4+8÷4	9÷3	14-2÷3	100.00%		5
BoMei	VnoR	Male	y=5 5+y=10	y=4 4+2y=12	1	3-2	3+5	7-3÷2	4+	9÷3	14-2÷3	83.33%		4
BoMei	VnoR	Male	5+y=10 5=y	y=4 4+y+y	2	1	3+2	7-3÷2	4+	9÷3	14-2÷3	66.67%		4
BoMei	VnoR	Male	5=y	4=1y	0	1	8	7-2÷3	12	3	4	50.00%		4
BoMei	VnoR	Male	5+y	4+y	1	1	8	2	12	3	12	66.67%		6
BoMei	VnoR	Male	5+y	4+y+y	2	1	8	2	8	6	12	50.00%		6
BoMei	VnoR	Male	5+y	4+y+y	2	5	8	5	8	3	6	33.33%		6
BoMei	VnoR	Female	5+y	4 y+y 2y	1	2	2	3y	16	9y		0.00%		6
BoMei	VnoR	Female	y=5	y=2	0	1	8	2	3	3	4	100.00%		6
BoMei	VnoR	Female	y=5	y=2	0	1	8	2	3	3	4	100.00%		6
BoMei	VyesR	Male	1y×5=	y+y=2y 2y×4=	0	1	8	2				100.00%	5	5
BoMei	VyesR	Male	5+y =8	4+y+y=4+2y	2	3	5	6	8	9	14	0.00%	6	5
BoMei	VyesR	Female	5+y=8	4+y+y=4+2y	2	3	8	6	12	3	9	33.33%	5	3
BoMei	VyesR	Female	5+y=10	4+2×y=14	2	1	8	4	4	3	6	50.00%	6	6
BoMei	VyesR	Female	5+y=10	4+2y=12	2	1	8	2	1	3	4	83.33%	6	6
BoMei	VyesR	Female	5+y=1-	4+2y=12	2	1	2	4	4	3	6	33.33%	6	6
BoMei	VyesR	Male	5+y=6	4+y+y+2y=12	1	5	8	4	12	3	4	50.00%	6	6
BoMei	VyesR	Male	5+y=6	4+2y=12	2	5	8	4	12	3	12	33.33%	6	4
BoMei	VyesR	Male	5+y=2y	y+y=2y 4×2y=	1	1	8	4	3	3	4	83.33%	5	5
BoMei	VyesR	Male			N/D	5	2	2y		3	4	40.00%	6	5
BoMei	VyesR	Male	5+3=8	4+6=10	0	1	8	2	3	3	4	100.00%	6	6
BoMei	VyesR	Female	5+y=8	4+2y=10	2	1	8	2	12	3		80.00%	6	6
BoMei	VyesR	Male	5+y=8	4+2y=10	2	1	8	3	2	8	6	33.33%	6	6
BoMei	VyesR	Male	y×5=10	4×y×y=12	0	1	8	4	12	9	12	33.33%	6	5
BoMei	VyesR	Female	5+y=8	4+(y×2)=10	2	1	8	4	12	3	6	33.33%	6	6
BoMei	VyesR	Male	5+y=10	4+y+y=12	2	1	8	4	3	3	4	83.33%	4	5
BoMei	VyesR	Male	5+y=7	4+y+y=7	2	1	2	4	2	3	12	33.33%	5	4
BoMei	VyesR	Male	5+2=7	y+4=3	0	11	8	2	4	6	5	33.33%	3	1
BoMei	VyesR	Female	5+y=8	4+2y=10	2	1	2	2	4	3	12	50.00%	6	5
BoMei	VyesR	Female	5+y=8	4+y+y=10	2	1	8	5	12	3	12	50.00%	6	6

Figure 13. Raw data with calculated data

Analysis process