

## **CHAPTER 3 METHODOLOGY**

This chapter described the methodology of this study, including research participants, research design, and procedure thoroughly with a brief explanation about the system that applied. Then the instruments, data collection, and data analysis that use in this study.

### **3.1 Research Participants**

Research participants in this study were a total of 22 students from Ching-Sui Elementary School in Taichung Taiwan, divided into two groups. The first group are 10 students as the experimental group, and the second group is 12 students as the control group. This elementary school student is a grade 5th student and has slightly understood about genetically modified food (GMF) before. Genetically modified food (GMF) chosen as the topic because it is the issue that risen in society nowadays, there are different perspective in people how to deal with the issue. Genetically Modified Food (GMF) is the Socio-Scientific Issue (SSI). Based on the (Sadler, 2004), SSI is defined as the social issue related to science and has ill-structured, open-ended problems which have multiple solutions. So the topic is very suitable to discuss in the knowledge building based learning environment.

### **3.2 Research Design and Procedures**

This study used quasi-experimental research to measure the effect of SDRS in students' perception of Knowledge Building-Based Learning Environment and Learning Outcomes. The quasi-experimental research purpose is to test the hypothesis of a causal descriptive cause-and many structural details to support the counterfactual inference if no treatment (Shadish, Cook, & Campbell, 2002).

The research design and procedure is shown in figure 4. The duration of this study conducted for 4 weeks with 2 hours' class per week. The main topic used for discussion is Genetically Modified Food with different subject matter every week. The students divide into two groups, the experimental and the control group. Both of group apply Knowledge Building-Based learning in the classroom. The experimental group was given the Synchronous Discussion and Reflection System (SDRS) to help in their reflection in the group discussion and the control group guided by the teacher in their discussion.

As we can see in table 1, the teacher during the class divided the students into small groups and provides articles and internet access for the student to looking for information while discuss and share their ideas within groups. The experimental group was given the Synchronous Discussion and Reflection System (SDRS) to help in their discussion and reflection as they will be self-directed learning while the control group with the teacher guided the discussion on the topic. From every week discussion, every group of student would obtain and report their discussion results about every week topic. This students group discussion results would analyze as the Knowledge Building-Based learning outcomes. Also, before and after this research conducted, students would be given the knowledge building environment scale (KBES) questionnaire to measure their perception about knowledge building-based learning.

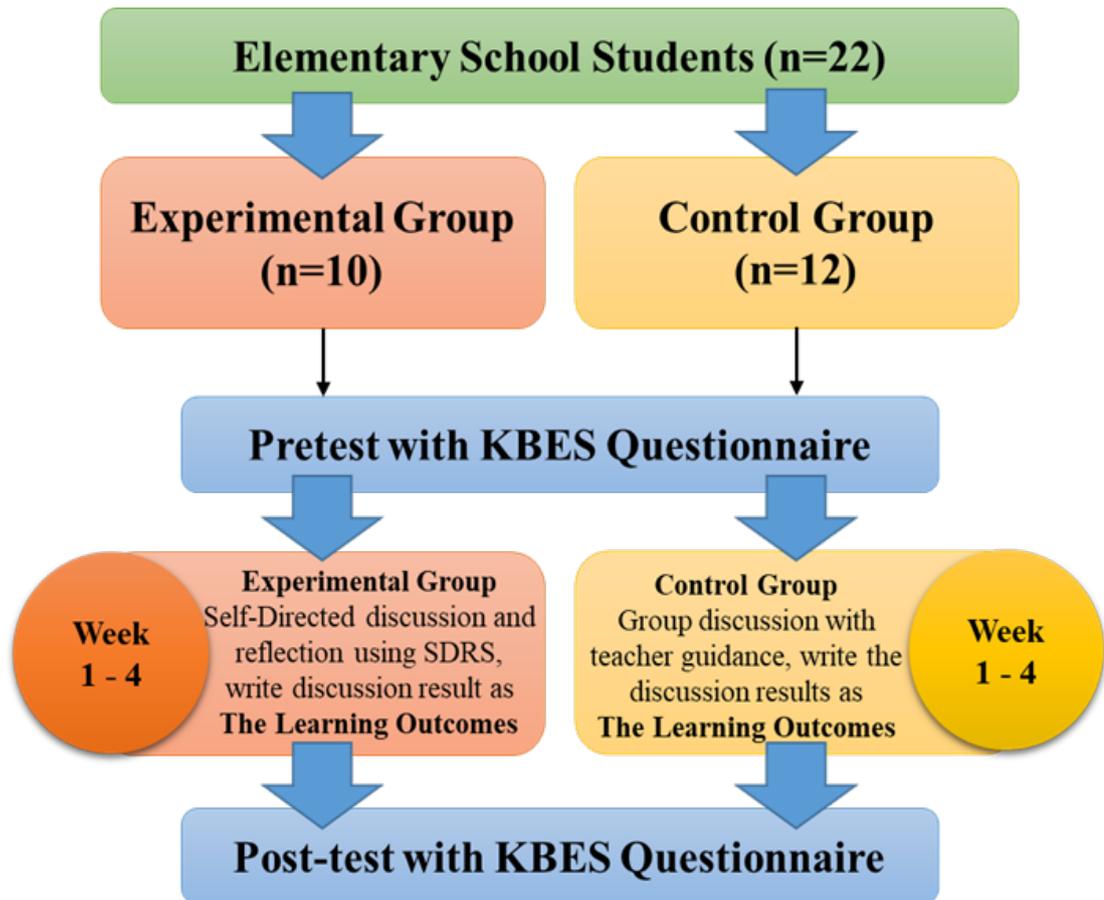


Figure 4. The Research Design and Procedure

Table 1. Knowledge Building-Based Learning Activity in Experimental and Control Group

Week	Experimental group	Control group
1 <sup>st</sup>	<ol style="list-style-type: none"> <li>1. Conduct a pretest with the KBES Questionnaire</li> <li>2. Teachers divided student into groups, provide articles, the tablet for internet access and query on the topic of genetically modified foods, each group of students discuss the topic and make a record using <b>the SDRS (Synchronous Discussion and Reflection System)</b>.</li> <li>3. At the end of the discussion, use <b>the SDRS (Synchronous Discussion and Reflection System)</b> to reflect.</li> </ol>	<ol style="list-style-type: none"> <li>1. Conduct a pretest with the KBES Questionnaire</li> <li>2. Teachers divided student into groups, provide articles, the tablet for internet access, and query on the topic of genetically modified foods, the teacher guided the discussion on the topic to form a Subtopic. <b>The topic of discussion: What are the genetically modified foods, what kind of genetically modified foods have you heard or touched in your life?</b></li> <li>3. Each group write the results of group discussion (learning outcomes)</li> </ol>

	4. Each group write the results of group discussion (learning outcomes)	
2 <sup>nd</sup>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods, each group of students discuss the topic and make a record using <b>the SDRS (Synchronous Discussion and Reflection System)</b>.</li> <li>2. At the end of the discussion, use <b>the SDRS (Synchronous Discussion and Reflection System)</b> to reflect.</li> <li>3. Each group write the results of group discussion (learning outcomes)</li> </ol>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods; the teacher guided the discussion on the topic to form a Subtopic. <b>The topic of discussion: What do you think are the advantages of GM foods? Why? What do you think are the shortcomings of GM foods? Why?</b></li> <li>2. Each group write the results of group discussion (learning outcomes)</li> </ol>
3 <sup>rd</sup>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods, each group of students discuss the topic and make a record using <b>the SDRS (Synchronous Discussion and Reflection System)</b>.</li> <li>2. At the end of the discussion, use <b>the SDRS (Synchronous Discussion and Reflection System)</b> to reflect.</li> <li>3. Each group write the results of group discussion (learning outcomes)</li> </ol>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods; the teacher guided the discussion on the topic to form a Subtopic. <b>The topic of discussion: Would you choose to use GM foods? Why? Do you think there is a need for government-related units to legislate to regulate GM foods? Why?</b></li> <li>2. Each group write the results of group discussion (learning outcomes)</li> </ol>
4 <sup>th</sup>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods, each group of students discuss the topic and make a record <b>using the SDRS (Synchronous Discussion and Reflection System)</b>.</li> <li>2. At the end of the discussion, use <b>the SDRS (Synchronous Discussion and Reflection System)</b> to reflect.</li> <li>3. Each group write the results of group discussion (learning outcomes)</li> </ol>	<ol style="list-style-type: none"> <li>1. Teachers provide articles, the tablet for internet access and query on the topic of genetically modified foods; the teacher guided the discussion on the topic to form a Subtopic. <b>The topic of discussion: Overall, do you agree with the continued production or use of GM foods? Why?</b></li> <li>2. Each group write the results of group discussion (learning outcomes)</li> <li>3. Perform post-test with KBES questionnaire.</li> </ol>

---

4. Perform post-test with KBES questionnaire.

---

3.2.1 Synchronous Discussion and Reflection System (SDRS)

The function of this system in knowledge building learning is facilitating student discussion, and it could help students in the process of reflection in a discussion. In this system, there is a record feature that can help students repeat or listen to the discussions they have done before. This system accessed via online.



Figure 5. The Login Screen of Synchronous Discussion and Reflection System (SDRS)

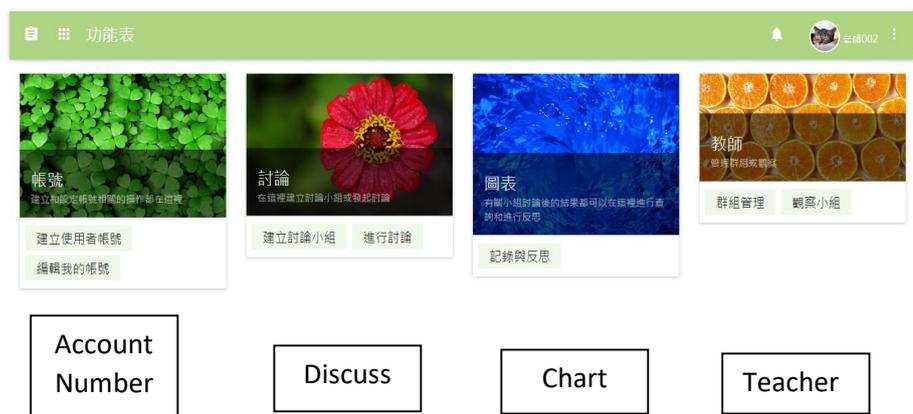


Figure 6. The Main Menu Screen of Synchronous Discussion and Reflection System (SDRS)

There are several features in the SDRS main menu as we can see in figure 6:

1. Account number (帳號), this menu is for setting up the account including creating and edit



Figure 7. Create and Edit Account Screen in Synchronous Discussion and Reflection System (SDRS)

2. Discuss (討論), this menu for setting up a discussion group and initiate the discussion. Figure 8 show which the active discussion topic and figure 9 show in the system to choose which member is the group member. The feature that shows in figure 10 is essential features; it is the record feature which can access by each member of the group. If each member wants to express their idea in the discussion, they have to click the play button on the screen, so their idea will be recorded. If they want to response the other idea, they have to also recorded in their own devices.



Figure 8. The topic of Discussion Screen in the Synchronous Discussion and Reflection System (SDRS)

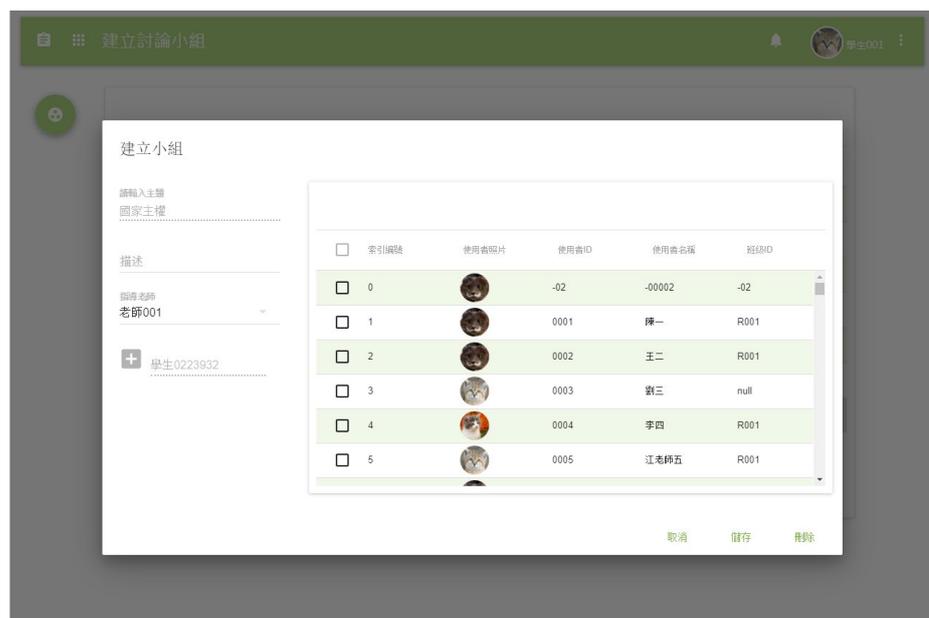


Figure 9. Choose the Group Discussion Member in Synchronous Discussion and Reflection System (SDRS)



Figure 10. Record Feature in Synchronous Discussion and Reflection System (SDRS)

3. Chart (圖表), this menu is to show the result of the discussion for reflection; in this menu, some features used for student reflection and self-assessment. First, in Figure 11 shows the topic of the past discussion, choose one of the topics to replay the recording of the past discussion (by clicking the green arrow in the right side of the topic). After clicking the topic, there are four features in the Chart menu. First is the Frequency of Speaking Chart. In the chart shows the frequency each student speak, as shown in figure 12. The second is the amount of speak time chart, shown in figure 13. In this chart, each student can see how long they speak and record in the discussion. The third is a discussion map within a group show in figure 14; there is a line that shows which student commented on which idea. The last is the speech recording of the student discussion, as shown in figure 14. Student can replay their recording in this menu so they can reflect their past answer.

記錄與反思				
篩選主題				
主題	描述	小組碼	狀態	選擇小組
熱帶雨林		s00000001	completed	➔
12 10		學生0075901	completed	➔
喜歡食品1		學生0090127	completed	➔
基飲		學生0093328	completed	➔
喜歡食品的好處		學生0112316	completed	➔
圖8	閱讀理解	學生0150759	completed	➔

Figure 11. The topic of the Past Discussion in the Synchronous Discussion and Reflection System (SDRS)

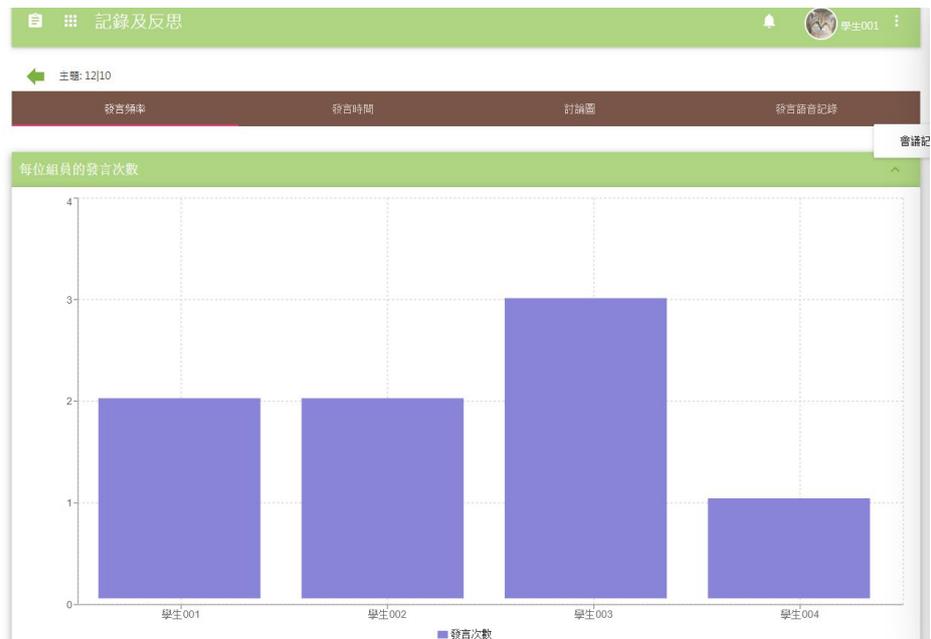


Figure 12. The Frequency of Speaking Chart in Synchronous Discussion and Reflection System (SDRS)

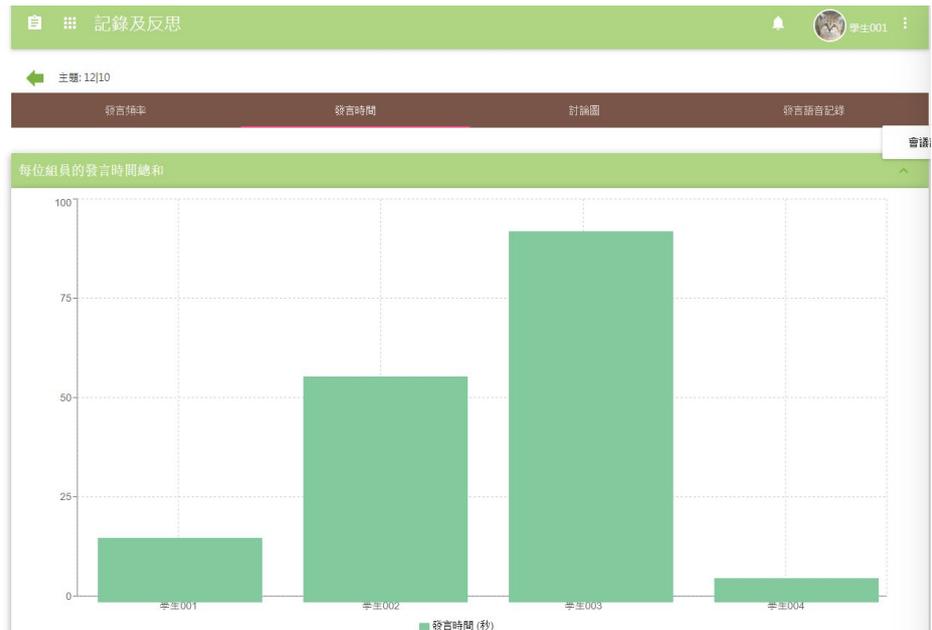


Figure 13. The Amount of Speak Time Chart in Synchronous Discussion and Reflection System (SDRS)

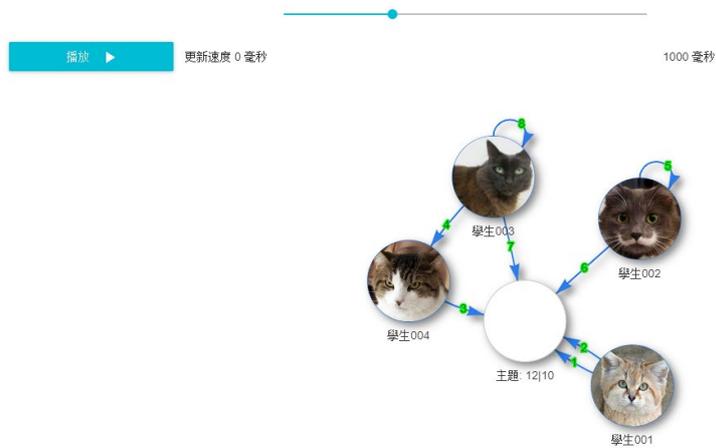


Figure 14. Discussion Map Screen in Synchronous Discussion and Reflection System (SDRS)

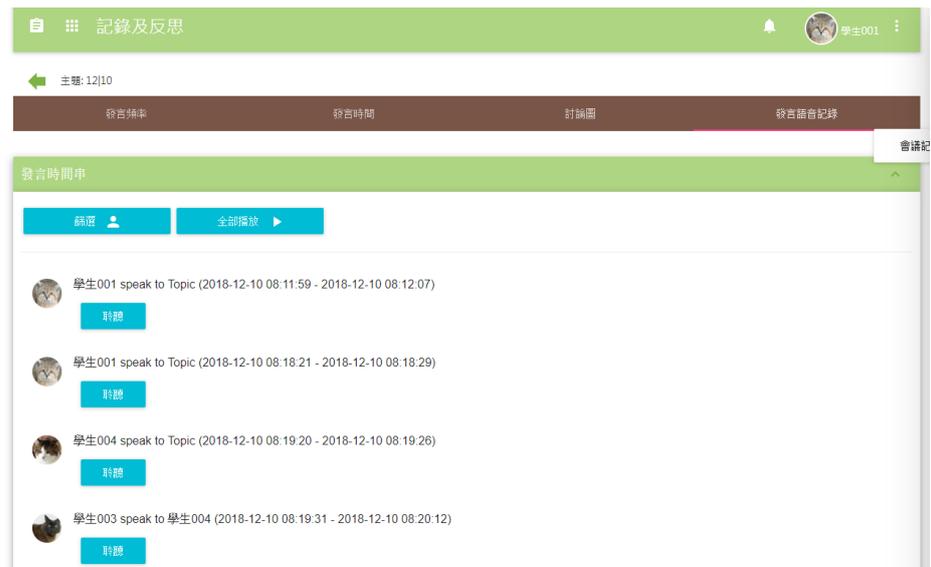


Figure 15. Speech Recording Screen in Synchronous Discussion and Reflection System (SDRS)

4. Teacher (教師), this menu is for the teacher to manage the group and to observe. In this menu, the teacher can observe which group is already done their discussion.

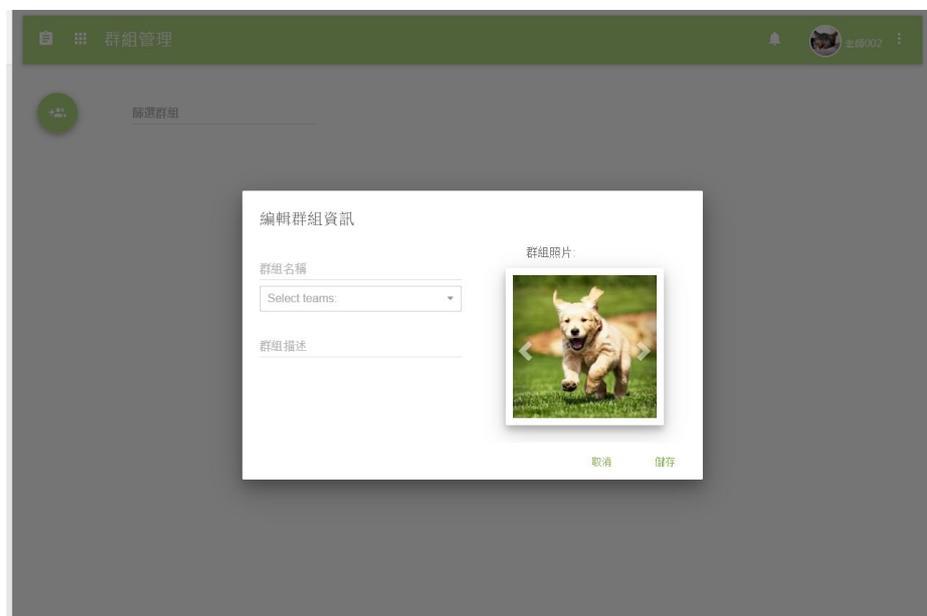


Figure 16. Make Card on the Teacher Menu in Synchronous Discussion and Reflection System (SDRS)

### 3.3 Instruments, Data Collections, and Data Analysis

In this study, two variables measured: student perception of knowledge building-based learning environment and the student learning outcomes from the group discussion. Student perception of knowledge building environment would be collected and measured by the KBES (Knowledge Building Environment Scale) questionnaire that adapted from Lin, Hong, & Chai (2014) based on the knowledge building pedagogy.

The questionnaire identified three factors as a core dimension that could reflect the creative extent of knowledge building environment in the classrooms; there were working with the idea (WI), assuming agency (AA), and fostering community (FC). The KBES uses a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). The scale scores range from 1 to 4, which indicating awareness of the knowledge-building environment. The higher the scores means a higher awareness of the students. The table below showed the sample items and the explanation on each factor in the KBES questionnaire (Lin et al., 2014).

*Table 2. The Sample Items and Explanations of factors in KBES Questionnaire*

<b>Factors</b>	<b>Sample Items</b>	<b>Explanations</b>
Working with Idea (WI)	<p><i>“In this course, all ideas in the class were worthy of consideration,”</i></p> <p><i>“In this course, sharing of ideas is not encouraged.”</i></p>	This factor emphasized the importance of idea exchange, elaboration, and deepening through understanding students' learning experiences in discourse.
Assuming Agency (AA)	<p><i>“In this course, one needed to plan and execute one’s learning plan.”</i></p> <p><i>“In this course, it is important to constantly</i></p>	The factor stressed the self-initiated and self-directed processes of improving knowledge. Students need to deal with problems of learning goals, motivation, self-

	<i>reflect on one's own learning status.”</i>	evaluation, and long-term planning for their learning at all times.
Fostering Community (FC)	<i>“In this course, the participation of all members in the community is important”, “In this course, all members have to actively participate in discussion.”</i>	This factor emphasizes the individual and collective cognitive responsibility for the advancement of knowledge by engaging learners to work together as a community to continuously produce, develop, and evaluate ideas.

These core dimensions could have reflected the learning process creative extent of the knowledge building environment in the classrooms. There was two Knowledge Building Environment Scale questionnaire that given to the student to measuring the student perception. The first questionnaire was given before the course started (pretest) to measure their prior information about their past learning experience. The second questionnaire was given to the student after the study conducted as a post-test. The second Knowledge Building Environment Scale Questionnaire was to measure the student perception in their knowledge building-based learning environment.

As we can see in Table 3, the KBES questionnaire data collected would analyze by the paired-sample t-test to compare the students’ perception of the learning environment from the experimental and the control group. Then, to compare if there were any difference between before and after the knowledge building-based learning environment applied in the class, the data analyzed with one-way ANCOVA.

The student learning outcomes collected from each week group discussion and analyze with qualitative analysis. Denzin & Lincoln (2005) defined qualitative research as “*multimethod in focus, involving an interpretative, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them*”. The qualitative research gathers the non-numerical data by observing. To understand more about the data, it needs qualitative analysis.

This study analyzes the students’ discussion learning outcomes through qualitative analysis. First, students’ discussion results were categorized based on their answer each week. For example, if the student answer is “*Genetically Modified Food is the food that produces from modifying the genetics of the plant or animal,*” so from the answer could analyze that the student's answer is into the category “*Definition.*”

From the categorized keywords of their discussion results, we could analyze by observing and counting their amounts of results and new categories that appear in their group discussion results each week. The amounts and category that appear in the discussion results from the experimental and control group per week would measure the students understanding and their knowledge construction about the Genetically Modified Food (GMF) in the Knowledge Building-Based Learning. More the amount of categories it means the student knowledge constructions are better.

*Table 3. Data Analysis Method*

<b>Data Collected</b>	<b>Analysis Methods</b>
Perceptions of Students Knowledge Building Environment (KBES questionnaire Pretest and Post-Test)	Paired Sample T-Test One-way ANCOVA
Students Learning Outcomes (Group Discussion Results)	Qualitative Analysis, categorizing, and counting the amount of keyword from the result.