S.E.E.S. 2010 between Taiwanese HSP and Japanese SSH

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Abstract: Taiwan and Japan regard education as an important national policy to bring up talented people who are going to play active parts in the international society. Taking notice of science education, Japan started Super Science High School (SSH) in 2002, and referring to SSH, Taiwan started High Scope Program (HSP) in 2006. To promote the relationship of these national scientific secondary education programs, the science education exchange symposium between Taiwanese HSP and Japanese SSH has been held every year since 2008. In Science Education Exchange Symposium (S.E.E.S) 2010, which was held in Japan for the first time, the objective was to recognize the status quo of the science education in Taiwan and Japan and share the developing cases and approaches and to build a foundation of an advanced science education program that both countries will continue to improve upon and develop together to be implemented throughout both countries. The students' presentation, the teachers' practical reports, and workshops informed each participant of each school's practical activities. And I think it was a great opportunity which each participant thought about the differences between these countries and the future possibility of cooperation by carrying out the competition cooperated with both countries and by building up the evaluation standards. In this presentation, I will report the achievements and problems clarified through S.E.E.S.2010.

Keywords : Science Education Exchange Symposium, Evaluation Standards, Competition

I. Introduction: Background and Aims of S.E.E.S.2010

Taiwan and Japan regard education as an important national policy to bring up talented people who are going to play active parts in the international society. Taking notice of science education, Japan started Super Science High School (SSH) in 2002, and referring to SSH, Taiwan started High Scope Program (HSP) in 2006. To promote the relationship of these national scientific secondary education, the science education exchange symposium between Taiwanese HSP and Japanese SSH has been held twice since 2008 in Taiwan with Japanese being invited. In these symposiums, specific and practical reports were made by the participating schools.

At Science Education Exchange Symposium between Taiwan and Japan 2008 held on May 31st to June 1st in 2008 at National Taiwan Normal University, the teachers and the students of 8 SSH schools and 27 HSP schools and the officers of Taiwan National Science Council (NSC) participated and presented their activities each other.

At Science Education Exchange Symposium between Taiwan and Japan 2009 held on November 16th to 17th in 2009 at Taipei Municipal University of Education, the teachers and the students of 5 SSH schools and 27 HSP schools participated. The teachers presented their practical study examples and the students presented their research projects each other. At these symposiums, keynote addresses and practical reports were made and they became very important opportunities that the differences of the aims or the ideas and the good points and the lacking points of both countries were shown clearly.

In the symposium 2008, Japanese teachers visited 2 HSP schools and felt Taiwanese students' enthusiasm and diligence for science study.

In 2009, the visits to the nature protection area of National Park and the nuclear power plant were made. Those gave us the possible ideas of fieldworks in Japan and made us feel the possibilities that our cooperative development in the energy field and the environmental education are going to grow in the future.

And also the Taiwanese preparations to take these symposiums in were perfect and impressed us Taiwanese enthusiasm for the cooperation with Japan. We really appreciate Taiwanese cooperation and hospitality.

In Science Education Exchange Symposium 2010 (S.E.E.S. 2010), to progress the relationship and good rivalry of both countries and to promote the development of more advanced science education programs and to spread them by adding the indicator of quantifying the change of the high school students through the science research projects and the creation of competitions to the contents of the symposiums of the past two years were aimed. In this thesis, I will introduce the outline of S.E.E.S 2010 and mainly report the evaluation standard of science research projects and the plans of science competition.

II. Contents of S.E.E.S. 2010

80 high school students and 93 teachers in table 1 participated in S.E.E.S. 2010. In addition, the officers from Ministry of Education, Culture, Sports, Science and Technology Japan and Japan Science and Technology Agency, the Governor of Shizuoka Prefecture, the deputy of the Mayor of Shizuoka City, researchers in universities, members of Japanese societies of science education, and from Taiwan, professors from Taiwan Normal University and Taiwan University, the officers of High Scope Program Promoting Office joined. The participating schools from Japan consisted in the six schools participated in the past symposiums and four new schools and those from Taiwan were the top ten schools which won the prizes in the science festival that was held in Taiwan and all 27 schools of HSP joined. Shizuoka Kita H.S. and Waseda University Honjo Senior H.S. from Japan and Jiango H.S. and Lishan H.S. from Taiwan took charge of this symposium. Table 2 is the annual schedule of S.E.E.S. 2010. The schedule was made up, based on the proposals of SSH, and being discussed with the representative teachers of HSP when we visited Taiwan in June.

Table 1 The Participants of S.E.E.S. 2010

Nation	Number of Participants	Names of Schools
Japan SSH	62 students 75 teachers	Shizuoka Kita High School, Waseda University Honjo Senior High School, Ritsumeikan Junior & Senior High School, Ritsumeikan Moriyama High School, Tokyo Tech High School of Science and Technology, Waseda University Senior High School, Kawagoe Senior High School, Tokai University Takanawadai Senior High School, Iwata Minami High School, Meijo University Senior High School
Taiwan	18 students	Taipei Municipal Jianguo High School, Taipei Municipal Lishan High

HSP	18 teachers	School, Taipei Municipal Zhongshan Girls High School, National Hualien Industrial Vocational High School, National Hsinchu Senior High School, National Miaoli Agricultural and Industrial Vocational High School, National Taichung First Senior High School, Ming-Dao High School, National Chiayi Senior High School

Table 2 Annual Schedule

Month	Contents
April -May	Conveyed the schedule of the symposium to the partner schools in Taiwan and Japan. Collected ideas of the valuation basis and the contents of the competition. Made up the materials which brought Taiwan based on these ideas.
June	The teacher of Shizuoka Kita H.S. and Waseda University Honjo Senior H.S. visited Taiwan. (4 days) While staying, the delegated students presented their research projects and the teachers tried the evaluation standard. In addition, the teachers discussed the contents of the competition which would be held in the symposium, gave a trial of work collaborating Taiwanese and Japanese students, and discussed the detail schedule, the contents, and the adjustment of the conditions of the symposium. After returning Japan, got the result of the discussion in shape and sent invitation proposals to SSH and HSP.
July	Made up the materials (e.g. abstract collections) for the symposium. Fixed the contents of the evaluation standard and the competition and sent the evaluation standard to each school. Communication and adjustments for the symposium.
August	Detailed preparation for the symposium. Open the symposium (6 days).
September -November	Collect the case examples and start making the report.
December	Held the report meeting and distributed the report.

Table 3 shows an outline of S.E.E.S. It was held at Shizuoka Kita High School and neighboring facilities on August 21st – 25th, 2010. The implementation method took the form a discussion based on the activities high school students did and the case examples teachers brought to. On the first day, we had an observation tour to Shizuoka Institute of Science & Technology with the concept of manufacturing. On the second day, we had a keynote address whose title was "The Differences of Secondary Science Education between Asia and Western Countries and the Future of Science Education in Taiwan and Japan" and confirmed the objective of the symposium. And after that, the high school students presented their research projects and the other high school students and the teachers evaluated them. On the fourth and fifth days, the high school students had competition programs and the teachers presented their own programs of science education and discussed them.

And on the fifth day, after touring some typical Japanese companies, we met and talked with a Nobel Prize winner.

Table 3 The Outline of S.E.E.S. 2010

Date	Time	Programs		
		High School Students	Accompanying Teachers	
Sat. Aug. 21	13:00-15:00	Campus tour of Shizuoka Institute of Science and Technology (SIST) Introduction of SIST by President Araki Inspection of the formula car with Professor Tsuchiya Inspection of the robot technology with Professor Masuda Visit Machine Accessory Center		
Sun. Aug. 22	10:00-10:20	Opening Ceremony Greetings of representatives		
	10:20-10:50	Keynote Address Yoshisuke Kumano Professor of Shizuoka University, Faculty of Education		
	11:20-12:20	Research Project Presentation and Evaluation		
	13:00-15:00	Research Project Presentation and Evaluation		
	15:30-18:30	Poster Session and Evaluation		
Mon Aug.23	9:00- 9:50	Lecture for Competition	Attend the Lecture with students	
	10:00-12:00	Activity for Competition	Presentation Program The teachers from 5 schools from SSH and 5 from HSP made their presentations (15-minute presentation and 10-minute Q & A) in English in front of the all participant teachers.	
	13:00-17:00	Activity for Competition		
	18:00-20:00	Activity for Competition	Inspection of students' Activity	
Tue. Aug. 24	9:00-11:00	Activity for Competition	Workshop Making 5 groups of about 10 teachers, 1 teacher from SSH and 1 teacher from HSP of each group offered their case examples of science teaching materials. The teachers experienced the method and discussed them.	
	12:00-13:00	Discussion	Session Based on the evaluating standards made for this, discussed it in the same group as Workshop.	
	13:00-14:00	Demonstration	Inspection of students' Demonstration	
	14:00-14:30	Presentation	Inspection of students' Presentation	
	14:30-15:00	Closing Ceremony(Commendation, Greetings of representatives)		
Wed. Aug. 25	8:00	Departure time of bus from hotels for Study tours to companies		
	9:00	Course-A	Course-B	Course-C
	10:00	Tamiya Inc	Bus	Bus

	11:00 12:00	Bus	Hamamatsu Photonics	Yamaha Motor
	16:30-17:30	The exchange conference between Dr. Masukawa(Nobel Prize winner) and the high school students. "Lecture in English by Dr. Nakamura from the same research group as Dr. Masukawa and Dr. Kobayashi(Nobel Prize winner).		

III. The Collaborative Development of The Standard to Quantify The Progress of High School Students through The Research Projects

1. Objective

The research project is a perfect opportunity to test what a high school student learned. Each school in SSH and HSP is putting a great deal of effort into it and instructs high school students to be able to observe exactly and quantitatively and explain it logically by their own ways. However, if partner schools could collaboratively make up a common indicator to evaluate quantitatively their achievement stages of enthusiasm or attitude for science study, knowledge, skills, the power of understanding, the power of expression, and thinking power and continue to do evaluating activities, the high school students would understand the points which would make the research progress and the teachers would be able to enhance the accuracy of the evaluation method based on the students' change.

2. Method

We developed the evaluation standard of the research project in cooperation with SSH and HSP as follows.

Table 4 The Development Process of The Evaluation Standard of The Research Project

Month	Execution Contents
April -May	Exemplifying the evaluation standard and collecting examples and advice.
June – July	Trial and improvement at the joint presentation by two SSH schools and two HSP schools.
August	The evaluation at S.E.E.S.2010 and improvement by Japanese and Taiwanese teachers.
September-	Summarizing and analysis.

2-1. Exemplifying the evaluation standard and collecting examples and advice

We proposed the evaluation standard as the table bellow as the first idea in collecting ideas from partner schools. This evaluation standard was developed by our school referring to *GCSE Science Coursework making system* in England and we introduced it at Science Education Exchange Symposium between Taiwan and Japan 2009 and it was used at Tokai Area SSH Festa sponsored by Meijo University Senior High School. The table 5 is the evaluation standard that we had used for our research projects presentation as a standard for teachers and guests and the 11th grade students for self-evaluation. We distribute this standard to the 11th graders and explain it a month before the presentation day and notice that the presentations will be marked by the judges using this standard. Students made self-evaluation teachers evaluated the research projects the ten items in the table below, graded from 1 to 5, which are 5: very high, 4:high, 3:a little high, 2:low, 1:very low. We adopted the ideas of *GCSE Science Coursework making system* in England in the item 2 to 7.

Table 5 The Evaluation Standard of the research projects presentations of Shizuoka Kita High School

Num.	The mark descriptions of the Research Project Presentation in Shizuoka Kita High School
1	Full of curiosity and inquiring minds and convey their enthusiasm and faith to others.
2	Collect sufficient information and conduct sufficient experiments and the motive of the study is clear.
3	The theme or the hypothesis is clear and have originality.
4	Define clearly that data is collected under the fixed condition (control variable), the changing condition (instrumental variable), and the changeable condition (response variable)
5	Put the process of experiments or investigations in order concisely, and explain the process of verifying hypothesis simply.
6	Put the evidence of experiments or investigations in order with using charts, graphs, or objective and concrete phenomenon.
7	Verify the hypothesis logically, and study the meaning of the evidence or the limit of its application.
8	Present with being aware of audience's understanding and without looking at manuscript, use eye contact and a pointer appropriately.
9	Present all planned contents within the limit time.
10	Deal with the questions from audience quickly and properly.

In the General Certificate of Secondary Education (GCSE) in England, they make the students submit the experiment reports called "Coursework" and score them by a standardized evaluation standard. In our school, we have developed the methodology quantifying achievement of high school students' research projects based on the evaluation standard of science of Coursework since 2008. The research projects at our school are evaluated by 8 items, "Planning," "Obtaining Evidence," "Analysing and Considering Evidence," "Evaluating" of Coursework, the numbers of days of activity at school, the numbers of times of overseas partnership activity, the number of times of presentation outside school, and the number of prize winning.

We exemplified the evaluation standard for research project presentation of Shizuoka Kita High School and collected advice and evaluation standards from Japanese partner schools.

2-2. Trial and improvement at the collaborative presentation by 2 SSH schools and 2 HSP schools

In June 2010, the teachers and the students of Shizuoka Kita High School and Waseda University Honjo Senior High School visited Jianguo High School and Lishan High School and the students of 4 schools presented their research projects in English. Then we teachers started consulting about the evaluation standard which we would use for S.E.E.S. based on advice and examples collected from Japanese partner schools. We confirmed that the evaluation standard we were making would not be the one to decide superiority or inferiority but would be a guideline for high school students to conduct their research and for high school teachers to understand the students' achievement levels clearly. In the meeting of Japanese teachers and Taiwanese teachers, we exchanged opinions on the evaluation sheet of research project presentation. We improved it based on the opinions and tested to mark it by teachers and students in the presentations we had during our visit in Taiwan. The improved points at the meetings are as follows.

- The number of marks should be changed into 4. The reason is to clear each item positive (4&3) or negative (2&1).
- As for item 1 and 3, they have too many contents to be judged, so they should be divided.
- "The study contents are full of curiosity and inquiring minds and the presentation conveys their enthusiasm and faith to others." to "The study contents are full of curiosity and inquiring minds." and "The presentation conveys their enthusiasm and faith to others."
- "The theme or the hypothesis is clear and has originality." to "The theme or the hypothesis is clear." and "The theme or the hypothesis has originality."
- According to the opinion that we should examine presentations, we added the item, "The design of slides is planned to accelerate understanding of the audience."

We made up the evaluation standard, the table 6, incorporating into the points above and sent it to the participants to S.E.E.S. 2010.

Table 6 The Evaluation Standard Used at S.E.E.S. 2010

番号 Num.	評価基準 The mark descriptions	得点 marks Good - Bad
①	好奇心や探究心があふれる研究内容である。 The study contents are full of curiosity and inquiring minds. 研究內容充滿好奇心與求知欲。	4・3・2・1
②	熱意と誠意が他者へ伝わる発表内容である。 The presentation conveys their enthusiasm and faith to others. 發表內容傳達了對他人的熱情與誠意。	4・3・2・1
③	十分な情報収集や予備実験によって、研究動機が明確化されている。 Sufficient information collection and experiments clarify the motive of the study. 收集足夠的資訊、進行足夠的實驗，研究動機明確。	4・3・2・1
④	研究テーマまたは仮説が明確である。 The theme or the hypothesis is clear. 研究題目或假設清楚明確。	4・3・2・1
⑤	研究テーマや仮説にオリジナリティーがある。 The theme or the hypothesis has originality. 研究題目或假設具有原創性。	4・3・2・1
⑥	同じにする条件（制御変数）と変える条件（操作変数）、変化する条件（反応変数）が何によって測られるかを明確に定義している。 Define clearly that data is collected under the fixed condition (control variable), the changing condition (instrumental variable), and the changeable condition (response variable) 在清楚的固定條件(控制變因)下收集自變因與因變因的數據。	4・3・2・1
⑦	実験や調査の手順が簡潔にまとめられており、仮説の検証過程を分かりやすく説明している。 Put the process of experiments or investigations in order concisely, and explain the process of verifying hypothesis simply. 實驗或探討的過程簡明有序，就驗證假設的過程做簡易的說明。	4・3・2・1
⑧	実験や調査の結果が表やグラフまたは客観的かつ具体的な事象を用いて整理されている。 Put the evidence of experiments or investigations in order with using charts, graphs, or objective and concrete phenomenon. 利用圖形、表格或客觀具體現象，依序呈現實驗或研究的證據。	4・3・2・1

⑨	仮説を論理的に検証することにより、結論の持つ意味や適用の限界について考察している。 By verifying the hypothesis logically, study the meaning of the evidence or the limit of its application. 驗證假設合乎邏輯，考慮到證據的意義應用的範圍限制。	4・3・2・1
⑩	スライドのデザインは聴衆の理解を促進するように計画されている。 The design of slides is planned to accelerate understanding of the audience. 簡報畫面之設計能促進聽眾之瞭解。	4・3・2・1
⑪	聴衆の理解度を意識し、原稿から目を離して、アイコンタクトやポインタ等を適切に用いた発表方法である。 Present with being aware of audience's understanding and without looking at manuscript, use eye contact and a pointer appropriately. 發表時不看稿子能顧及聽眾是否理解，能適當運用目光眼神及雷射指示筆。	4・3・2・1
⑫	予定していた発表内容をすべて制限時間内にプレゼンテーションすることができた。 Present all planned contents within the limited time. 將準備之發表內容於限制時間內完成發表。	4・3・2・1
⑬	聴衆からの質問の内容を迅速に理解し、分かりやすくかつ適切に応対できた。 Deal with the questions from audience properly and quickly. 迅速理解聽眾之提問內容，作出清楚且適切之應對。	4・3・2・1

2-3. The Evaluation Activity at S.E.E.S. 2010 and The Improvement by Taiwanese & Japanese Teachers

In S.E.E.S., students presented their research projects and teachers and students evaluated them with using table 6, and then teachers discussed the evaluation standard.

- The presentations by students

  We organized 4 section groups mixed with Taiwanese and Japanese students in the presentation and the students presented in English (15-minute presentation & 10-minute Q & A). The table 7 shows the number of groups and themes of their researches.

- The evaluation activity by students and teachers

  Taiwanese teachers and students and Japanese teachers and students selected section groups freely and evaluated the presentations they listened to with using the 4 levels in the table 6.

- The teachers' discussion

  Looking back on the evaluation activity and comparing with the evaluation ways of their own schools, the teachers exchanged their opinions.

Table 7 The Group Numbers and The Themes of The Presentations By students at S.E.E.S. 2010

Num.	Title
1-01	Superconductive speaker (Maglev speaker)
1-02	Compound Eyes Positioning System
1-03	AC Generation by means of Stirling Engine
1-04	Research on Fluorescence of Luminol with Simple Examining Device
1-05	Developing a robot hand which is able to control in a long distance with wireless data communications
2-01	Studying on the locomotion of legs and step phase in ensign wasps (Evania appendigaster)

2-02	How the environment affects plants
2-03	The preference of host plants in Drosophila elegans
2-04	The effects of excessive strain from conducting presentations to the skin conductance and heart beats
3-01	Electricity from Black ghost fish
3-02	Feeding preference of the Bluegill Sunfish
3-03	YWHAZ(14-3-3zeta) involves in the metastasis of lung adenocarcinoma through Wnt signaling pathway
3-04	Bioremediation using Aboriginal Denitrification Rhodobacter to Eradicate “Blue Devil”, Water Hyacinth (Eichhornia crassipes)
3-05	Establishing Anaerobic-Ferment Production System through the Process of Hydrogenation-Methanation
4-01	Cutting and Dividing Polyhedrons and Filling a Space using Origami
4-02	Plastic Copper-Plating
4-03	Measuring the air drag in Hawaii
4-04	The Feasibility Evaluation for Sintering Stone Sludge Lightweight Aggregate
4-05	TLE Triangulation Observations by Japanese High School Students During a Space Educational Project of the SSH Consortium. An example of “grafting jet”

2-4. The Summary of Analysis

Dividing the items in the table 6 into 3 domains of enthusiasm, study (plan, method of verification, consideration), presentation skill like table 8 below, I will analyze the results of the evaluation activity of 3 above.

Table 8 The Domain Division of The Evaluation Standard

Num.	Domain		The mark descriptions
1	Enthusiasm		The study contents are full of curiosity and inquiring minds.
2			The presentation conveys their enthusiasm and faith to others.
3	Study	Plan	Sufficient information collection and experiments clarify the motive of the study.
4			The theme or the hypothesis is clear.
5			The theme or the hypothesis has originality.
6		Method of verification	Define clearly that data is collected under the fixed condition (control variable), the changing condition (instrumental variable), and the changeable condition (response variable)
7			Put the process of experiments or investigations in order concisely, and explain the process of verifying hypothesis simply.
8		Consideration	Put the evidence of experiments or investigations in order with using charts, graphs, or objective and concrete phenomenon.
9			By verifying the hypothesis logically, study the meaning of the evidence or the limit of its application.
10	Presentation skill		The design of slides is planned to accelerate understanding of the audience.
11			Present with being aware of audience’s understanding and without looking at manuscript, use eye contact and a pointer appropriately.
12			Present all planned contents within the limited time.
13			Deal with the questions from audience properly and quickly.

Table 9 shows the number of the teachers and the students who participated in the evaluation activity in the table 7. There is no big difference in the numbers of teachers and students among presentations.

Table 9 The Numbers of Participants in The Evaluation Activity of The Presentations

Presentation	1-01	1-02	1-03	1-04	1-05	2-01	2-02	2-03	2-04	3-01	3-02	3-03	3-04	3-05	4-01	4-02	4-03	4-04	4-05
Teachers	18	14	18	20	19	12	14	12	12	20	18	18	15	13	11	15	11	10	15
Students	18	17	17	17	23	11	13	11	11	15	16	14	13	13	13	13	13	15	12

In the results of scoring with using the table 6, I define 4 and 3 as positive and 2 and 1 as negative. In addition, in case all evaluators mark positive or negative in a research presentation, I define that agreement rate is 100%, and in case 90% and 80% of evaluators mark positive or negative, I define that agreement rate is 90% and 80%. Fig.1 shows the cumulative frequency of the number of researches which have more than 80% agreement rate of teachers for item 1 to 13 in the table 6, the breakdown of more than 80% are divided into 3 distributions which are 100%, more than 90% and less than 100%, and more than 80% and less than 90%. Fig.2 shows the same results as Fig.1 about student evaluators. The agreement condition is that all items are positive except for the item 13. And since the researches the students presented are the 19 researches in the table 7, the maximum value of Fig.1 and Fig.2 is 19.

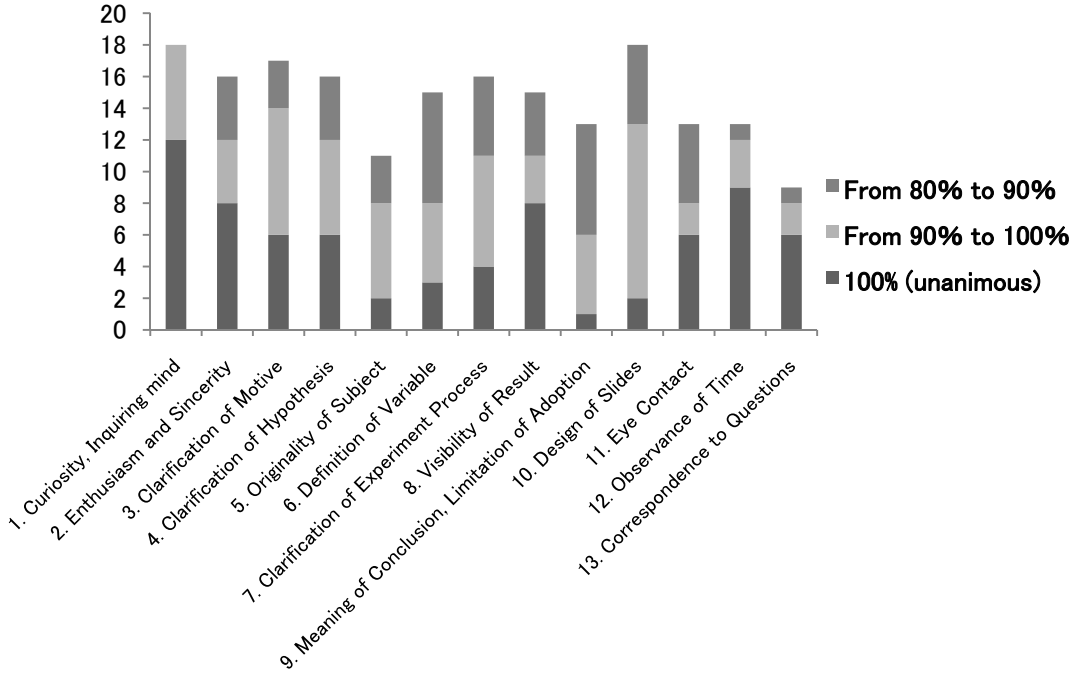

Fig. 1 The Number of Researches (Total 19) in Each Agreement by Teachers

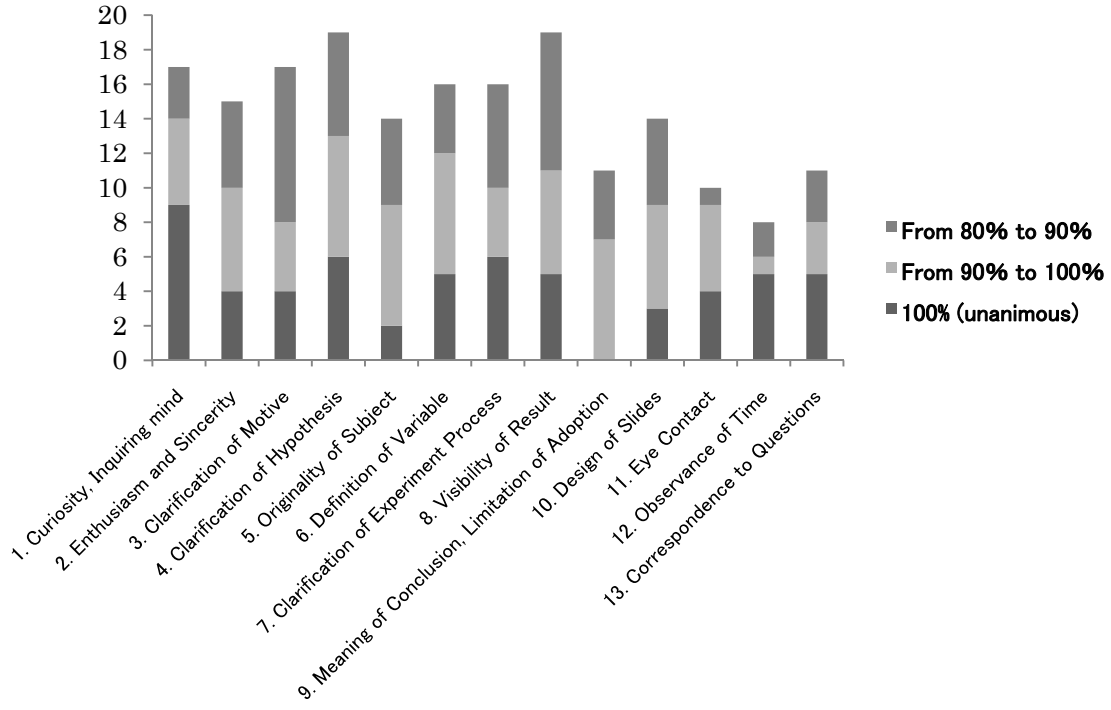

Fig. 2 The Number of Researches in Each Agreement by Students

a. The evaluation for Enthusiasm

The ratio of 100% agreement of "Item 1 The study contents are full of curiosity and inquiring minds" is the highest of all items of Fig.1 &2. "Item 2 The presentation conveys their enthusiasm and faith to others" has lower agreement rate but the tendency of teachers' marks and students' ones are similar. It can be thought that since the presentations were the representative ones from each school, most of the evaluations of enthusiasm were positive. According to the discovery that the evaluations of enthusiasm tend to agree, I found it would be necessary to devise a means of measuring enthusiasm.

b. The evaluation for Plan

Though the ratio of 100% agreement of "Item 3 Sufficient information collection and experiments clarify the motive of the study" and "Item 4 The theme or the hypothesis is clear" is about one third common to both teachers and students according to Fig.1 and Fig.2, all evaluators' marks agreed in more than 80% agreement. I found it was a comparatively easy standard for researchers and instructors to evaluate. As for "Item 5 The theme or the hypothesis has originality," more than 80% agreement is about half of all presentations. Since this item needs knowledge for evaluators, there is some unevenness. In evaluating originality, it is necessary to define a universal set to be evaluated. For example, "in a high school guidance field" or "in the most advanced field" it is necessary to clear which field the originality belong to. According to Fig. 2, the students' agreement rate of item 5 is higher than the teachers'. It can be thought that this is because the students might compare the presentations with their own presentations, or it is an accumulation of the evaluations by the students whose research field is close to the presenter's.

c. The evaluation for Method of Verification of research

As for “Item 6 Define clearly that data is collected under the fixed condition (control variable), the changing condition (instrumental variable), and the changeable condition (response variable)” and “Item 7 Put the process of experiments or investigations in order concisely, and explain the process of verifying hypothesis simply”, according to Fig.1 and Fig.2, the evaluation of both teachers and students can be confirmed more than 80% agreement in the evaluation of 70 - 80% of all presentations. It is thought that the students usually practice to control variables and to integrate verification processes. From these points of view, I found this domain is easy to quantify the students’ progress

d. The evaluation for Consideration

As for “Item 8 Put the evidence of experiments or investigations in order with using charts, graphs, or objective and concrete phenomenon”, almost all of the evaluators of both students and teachers agreed in more than 80% agreement according to Fig.1 and Fig.2. The reason that the ratio of teachers is higher than that of students in 100% agreement can be thought that teachers are more accustomed to read graphs and so they are more insusceptible to tastes. And also, it is possibly thought that the students unevenly understand the scientific meaning of “objective” or “concrete.” From these, I found that to capture the change of the way of showing consideration was an important standard to quantify the developmental stages of a student’s scientific literacy. “Item 9 By verifying the hypothesis logically, study the meaning of the evidence or the limit of its application” is the only item that there was no 100% agreement in Fig.2 and in Fig.1 the number of 100% agreement was the least. It is considerably difficult for high school students to examine the results taken from experiments critically and consider the meanings of the results or the limit of application. So, to make students remind the standpoint like the item 9, teachers’ ways of asking questions are the keys. And this is why the teachers who ask questions need to have much knowledge. It can be said that to settle the steps to the level that fills the item 9 is an important future challenge in secondary schools.

e. The Evaluation for Presentation Skill

As for “The design of slides is planned to accelerate understanding of the audience,” compared with 100% agreement in “more than 80%” of Fig.1, the agreement of more than 80% of Fig.2 is about 70%. Judging from it, it can be assumed that teachers capture understandability sensibly and students add the impact of colorfulness, figures, pictures, and movies to the evaluation. If I can segment the design skills that promote understanding, it might be possible to make a clear standard to measure the students’ developmental stages. As for “Item 11 Present with being aware of audience’s understandings and without looking at manuscript, use eye contact and a pointer appropriately,” while the agreement of “more than 80%” of Fig.1 is about 70% of all presentations, that of Fig.2 is about 50%. According to consideration from the image recording, almost all of the presentations were done without looking at manuscript and with looking at audience, so the teachers’ evaluation suits better. The reason is thought to be that the way of understanding the word “appropriately” is very uneven. “Item 12 Present all planned contents within the limited time” is

the same as the item 12, according to the consideration from image recording, we can find that the number of the presentations that finished within the limited time is almost the same as the number of more than 80% agreement. This clarifies the teachers' evaluation suits better than the students'. The reason that the students' evaluations did not agree is that they gave negative evaluations for the presentations which finished earlier than the limited time. In "Item 13 Deal with the questions from audience properly and quickly," since the evaluation for the presentations which had no questions were not defined, the agreement rate of both teachers and students was low.

2-5. Future Task

My future task is to set the viewpoint to judge the achievement steps. The present indicators are marked by 4 levels; "4 very high, 3 high, 2 low, 1 very low," however I need to research to standardize the achievement steps. As an example, I illustrate the viewpoint evaluation of Item 6. By separating each of 4 evaluation levels into "a" and "b", to decrease the unevenness of points is the next target.

Table 10 Example of The Viewpoint Evaluation of Item 6

Score	Mark	Evaluation Standard for Viewpoints
4	4a	Using detailed scientific knowledge and understanding to plan and convey a certain suitable technique, and considering necessity to create correct and reliable evidence and in case of prediction, necessity to verify it.
	4b	Using related information from earlier researches in a suitable occasion to mention the plan.
3	3a	Using scientific knowledge and understanding to plan and convey a certain procedure, and specifying, changing, restraining, considering important factors, and predicting it in a suitable occasion.
	3b	Deciding a suitable range and size to collect the evidence.
2	2a	Planning to collect the facts to make them certain.
	2b	Planning to use suitable preparation and information source for the evidence.
1	1a	Explaining a simple procedure.

IV. Competition

1. Collecting Ideas

In April 2010, enclosing the outline of S.E.E.S. 2010 to our partner schools in Japan, I sent the outline of the competition as follows and ask them ideas of it.

Title	Contents	Date
Lecture	Acquire a basic knowledge for Activity in English.	Morning / 2nd day
Activity	Make the groups of 4 students mixed Japanese students with Taiwanese students, conduct an experiment or practice, and make a manufactured product for Demonstration. The instruction is done by professors and high school teachers.	Afternoon / 2nd day Morning / 3rd day

Discussion	Write a paper in cooperation on intention of manufacturing in the Activity. In addition, discuss a strategy of the competition.	Morning / 3rd day
Demonstration	Compete in the products of Activity in the way of making the ranks clear.	Afternoon / 3rd day
Presentation	The students in the 1st to 3rd rank teams in Demonstration present the ideas of the product in English.	Afternoon / 3rd day

The following are ideas from Japanese SSH; Waseda University Honjo Senior High School, Nara Women's University Secondary School, and Ritsumeikan Moriyama High School. Each idea clearly defines by what the fixed condition (control variable), the changing condition (instrumental variable), and the changeable condition (response variable) is measured. So we could use these as the examples when we asked Taiwanese schools to give ideas for the competition. And we also referred to these when we made detailed rules of the competition of the symposium.

Table 11 Ideas from Japanese SSH

Idea 1 Produce a car which runs on a rubber band Make students produce cars which instructors designed in advance and have much room to improve. Explaining how to use the tools and giving instructions, instructors explain points to improve. Then instructors introduce rubber band power cars from several books or wed sites to students and let them have eagerness to produce better cars than those. Students proceed on producing with discussing problems on producing, the strength of the body, the force of friction against the floor, the relation between the power of a rubber band and the duration, the ideas to make the car run straight, how to transmit the power, and the stability of movement and with improving cars.
Idea 2 Produce a robot with plastic bottles and motors Give students a common assignment such as, "able to grasp an object and lift it." The number of bottles and motors changes depending on what will be produced. The assignment is checked at the demonstration after completing and students present their ideas and appeal points.
Idea 3 Produce a Spaghetti Bridge Give students the same amount of spaghetti and glue. A bridge which withstands the heaviest load shall win.
Idea 4 Produce a speaker Give students a common electromagnet, and they produce a speaker which makes a loud sound. Students come up with a paper cone.
Idea 5 Produce a solar boat Give students a solar panel, a motor, wood (e.g. balsa), and materials for a screw (an axle with a metal disc has not been worked for a screw, and it can change the size, the number, and the angle of wings) in common. Students launch their boat and compete the time. The shape of the boat and the screw should be variables.

2. Exchange Ideas with Taiwanese Teachers

The teachers and students of Shizuoka Kita High School and Waseda Honjo Senior High School visited Taiwan in June 2010. We brought Idea 1 above and discussed the contents and how we would implement it. The given opinions are as below,

- The competition should be held not in special rooms but in normal classrooms so that they can be used as teaching materials in the future.
- The contents should not be told in advance because it is impartial in case we rank the teams.
- To make the materials for the products impartial, it is better to fix money and to produce it within the budget.
- Since the students' competition and the teachers' presentation are done at the same time, there should be some intervals between the teachers' presentation program so that the teachers can observe the students' activity.

We brought back these ideas and the records of "Produce recursion formula from an experiment with a mathematical puzzle" and "Produce a model of a green energy house for carbon reduction" held at Jianguo High School and Lishan High School, and made up contents, rules, and implementation method of Competition in S.E.E.S. 2010.

3. The Contents of Competition

a. The Time Schedule

Table 12 Time Schedule of Competition

Date	Time	Program	Place
23th Aug.	9:00-9:50	Lecture	Gymnasium
	10:00-20:00	Activity	Each class room
24th Aug.	9:30-11:00	Activity	Each class room
	12:00-13:00	Discussion	Each class room
	13:00-14:00	Demonstration	Gymnasium
	14:00-14:30	Presentation	Gymnasium

b. The Theme

"THE PRODUCTION OF A MACHINE STOPPING AT JUST 10m"

Each team produces a machine which stops at just 10m.The materials for a machine are given to each team. (The extra materials can be exchanged by a coupon.) The power must use rubber. A team producing the machine which is the nearest to 10m becomes the winner.

c. Lecture

The teachers explained the contents, the rules, and the cautions of activity. After the lecture, the students drew lots to decide groups. And then they moved to the classrooms and started the activity.

d. Activity

Before they started the activity, they had some icebreaking time, e.g. names, school names, like to do, and specialties, and started to discuss the production of their machines. They proceeded their production, understanding Competition Rules below, following Production Rules below, and using Preparations below.

Competition Rules

- The machine to produce is powered by rubber. No limit the number of the rubbers for use. In addition, if rubber is used, you can use other power in given materials.
- The width of the course is 2m, and you start the machine at the starting area (50cm×50cm)(Fig.3)
- The measurement is performed in the mark written down to the machine from the 10m line in a goal. It doesn't matter if the machine go over the 10m line. (Fig.3)
- During the competition, a person must not enter the course including a goal.
- You can set up launching devices in the start area, but must not set up any devices in the course and the goal. The rubber power must be used for the machine which departs from there when you used a launching device.
- If the machine moves over the air, it must contact the ground 3 times at the least before it arrives at the goal.
- When the machine is out of the course, it will be judged to be a foul. The course is less than 2 m in width partitioned off with tape. A machine must not hang in the tape. (Fig.4)
- When the machine cannot stop within three minutes, it is judged to be a foul.
- You can do test run at a part of the competition course only in decided time.
- The data of the test run at the competition course is 8/23 18:00-20:00、8/24 10:00-11:00.

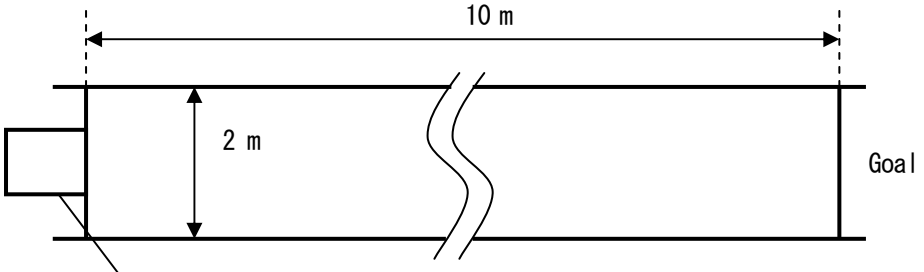

Fig.3 The Course of Demonstration

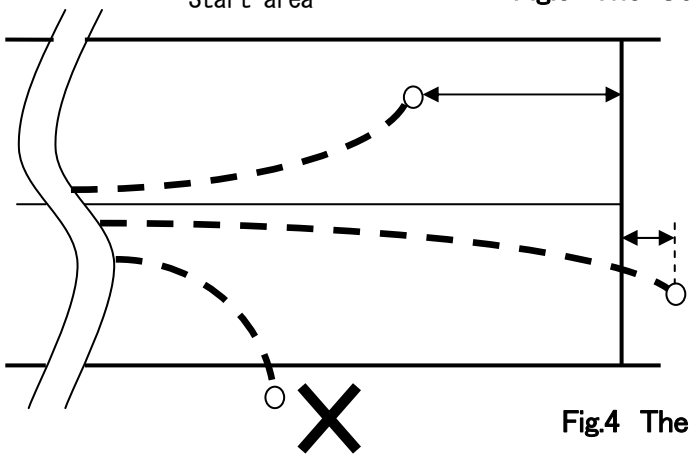

Fig.4 The Rules of Demonstration

Production Rules

- The materials to use for the production of the machine are common things given to each team.
- Each team receives five pieces of coupons. When you want to obtain materials except the given things or add some materials, you can use this coupon. You can trade with one item per one piece of coupon.
- The machine to produce is powered by rubber. No rule for uses and the number of the rubber.
- When you used a launching device, the rubber power must be used for the machine which departs from there.
- The size of the machine must stay in the start area (50cm×50cm) , and no part must protrude. But no limited for the height. (Fig.5)
- Write the mark on the tip of the machine used for the measurement.
- You must complete making the machine on time of Activity. But you can use the time of Discussion for production depending on a case.

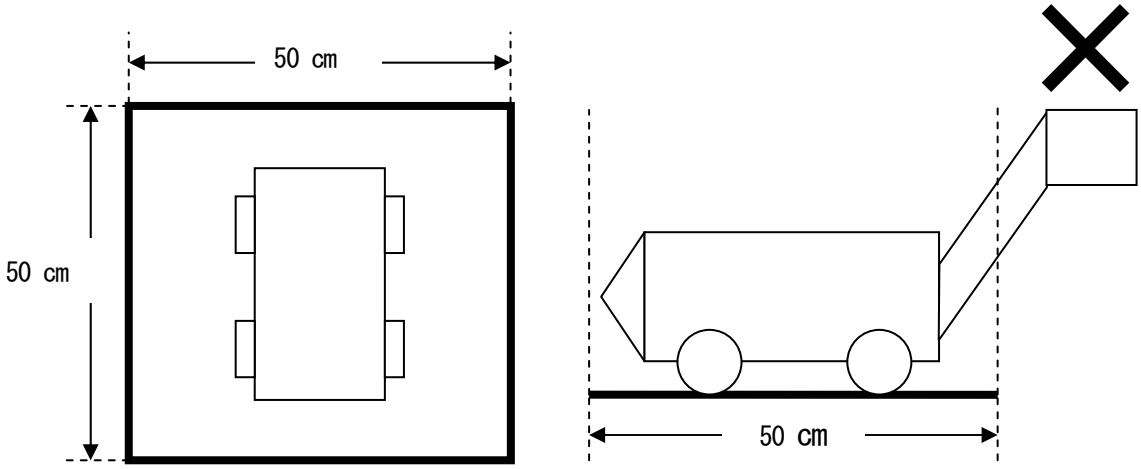

Fig.5 The Regulation of The Size of The Machine

Preparations

- Materials (which are common throughout each team)

  craft board, plywood, wood (a log, squared lumber), rubber (a rubber band, thread rubber), nail, Heaton, wooden screw, CD (DVD), Styrofoam, PET bottle, wire, thread, thumbtack, glass marble, pulley, straw, bamboo wire
- Tools

  scissors, a cutter, cellophane tape, plastic tape, packing tape, bond, adhesive, a saw, a hammer, a driver, a gimlet, an eyeleteer, a cord reel (an extension cord), a file (woodwork, paper), compasses, a ruler, a measure (1in the classroom) electric drill (1in the classroom)

*When you want to obtain some materials except the given things or add some materials, you can use given coupons.

Fig.6 Pictures of Activity

4. Discussion

Though each team was scheduled to have a meeting for the demonstration, almost all teams were doing a final check or fine-tuning their machines or continued to produce their machines.

5. Demonstration

Following the Competition Method below, each group competed their machines.

Competition Method

- The competition is performed by a preliminary and final contest.
- In the preliminary, four teams play a game all at once, each team gets score as the good results by 3 times of competitions, and high rank 8 teams can advance to the final contest. When you made the foul by 3 times of competitions, it will be judged to be disqualification.
- The final contest is performed in the same way as the preliminary, and it will decide a game with the good result by two times of competitions.
- In the waiting time of the competition, each team admits adjusting the machine. But we cannot admit that you adjust the machine until the teams participating in the final contest is decided after a competition of the third of the preliminary.（After the end of the competition for the third preliminary, the machines of each team are kept temporarily in the headquarters. After the announcement that who participates in the final contest, it will be returned to each team.）
- Final contest participation team will get adjustment time of 10 minutes for the final contest, and decides the group of it in this time.
- High rank three teams of the final contest are commended, and the three teams perform their own presentations about the machine they made.

Fig.7 Pictures of Demonstration

6. Presentation

The 3 highest rank teams of Demonstration gave presentations about their machines in front of everybody. Presentations were done orally with their machines. Each presentation had 10 minutes (5-min. presentation, 3-min. Q&A, and 2-min. taking turns). The presentations were not graded and done in order that the 3rd place, the 2nd place, and 1st place.

Fig.8 Picture of Presentation

7. The Change of The Students

At the early stages of Activity, each group was working over the design of the machine (car). Since there were a lot of conditions and variables in a concrete design, such as power, shape, and materials of the machine, it took the students much time to give individual ideas and there was less communication in each group. All 19 groups selected a car as a machine because 4 CDs and a caster were included in the materials given first. 14 groups made four-wheeled ones and 5 groups made tricycles. Many of four-wheeled groups used 4 CDs as wheels. The tricycle groups used 2 CDs and a caster or a wheel they made themselves. Many groups produced some parts experimentally, but only a few groups drew plans.

After 5 or 6 hours passed from the start of Activity, many groups finished deciding the power, and we could observe the students running their machines experimentally in the hall. Once the machines became to run, the students started to discuss the details such as stability of going straight or ideas of stopping the machine. As for the ways of braking, 16 teams controlled the power, and 3 teams wound string. Communication in groups was promoted quickly because they had a machine in front of them, they could discuss with moving their machine, and decrease the variables.

V. Conclusion

In this thesis, I reported S.E.S.E. 2010 held collaboratively Taiwanese HSP and Japanese SSH and making up an evaluation standard of research projects and an analysis of the competition in it. In making an evaluation standard, I developed it for the purpose of quantifying high school students' change through their research projects in collaboration with Taiwanese teachers. With the 13 items which we made collaboratively, teachers and students evaluated the research projects presented in by the students in S.E.E.S. 2010. The tendency of the agreement between positive and negative in the clarification of motives and hypothesizes, the definition of variables, and the arrangement of processes and results according to the results of the analysis of it, and from this, I found that Taiwanese students and Japanese students are having the instructions of researches which make students decide their themes carefully and design the experiments to prove their hypothesizes. In the originality of hypothesize, the meaning of conclusions, and its limitation of adoption, the agreement rate was low, and it showed the instruction method or the environment had not been settled. In the competition, we organized the mixed group of Taiwanese and Japanese students and held "The Production of a Machine Stopping at Just 10 m." We could observe the trigger which could promote the students' communication and the scene the students controlled the variables independently. Based on the fruits and the tasks cleared in this symposium, I will make effort to improve teaching methods and develop curriculums by international collaborations and comparisons.

Lastly, I'd like to express my gratitude to the students and the teachers cooperated and supported in holding S.E.E.S. 2010.