



NATIONAL INSTITUTE OF TECHNOLOGY  
AKASHI KOSEN COLLEGE JAPAN  
明石工業高等専門学校

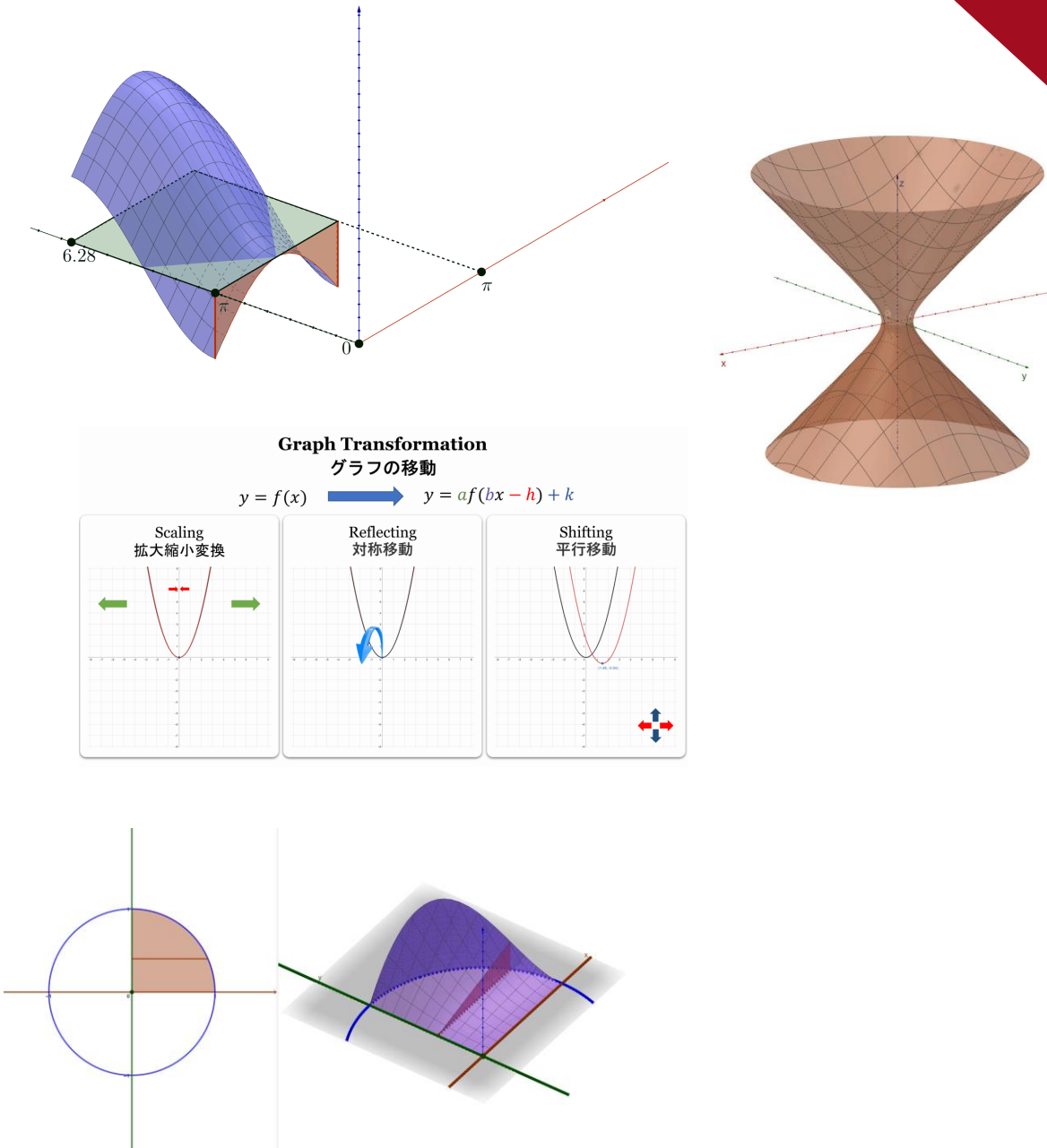
GLOBAL EDUCATION CENTER  
グローバルエデュケーションセンター

# Harnessing the Power of Graphic Calculators: A Key to Success in the Math Bilingual Education Program at NITAC

Prepared by:

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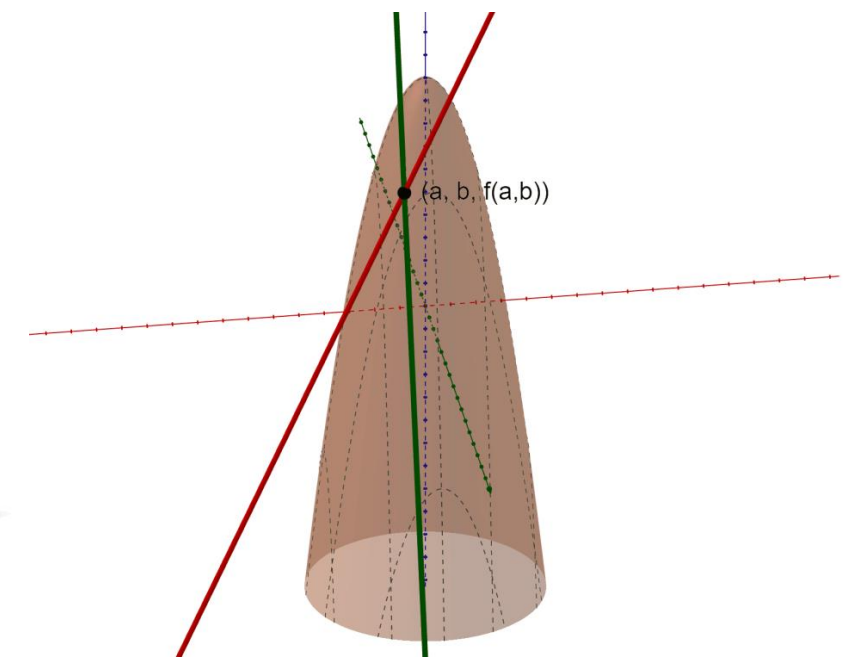
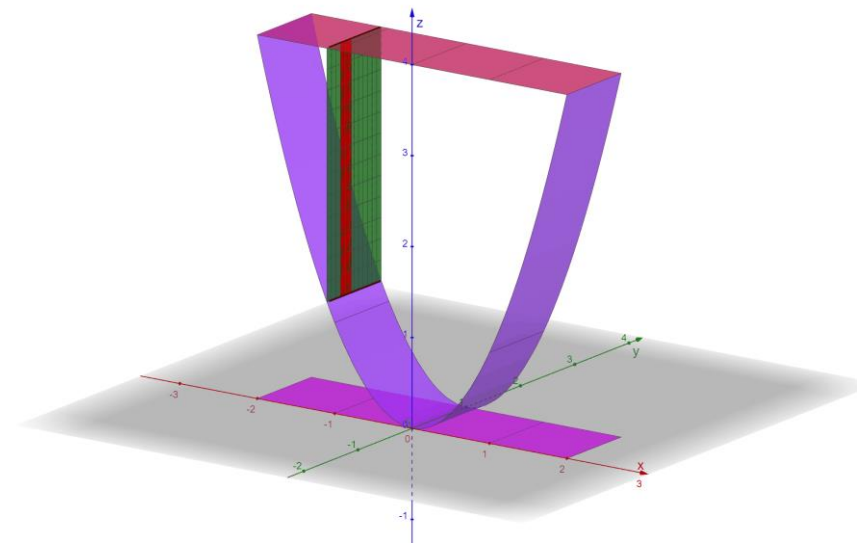
# Objectives:

**Provide brief overview of the Math Bilingual Education Program**

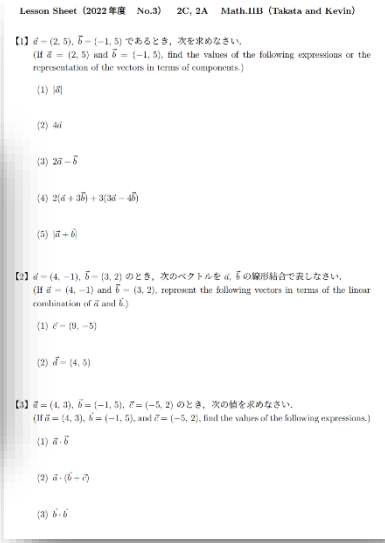
**Explain that the evaluation of the program covered three aspects:**

- **Program Components,**
- **Effects on Student Math Performance and Capabilities, and**
- **Emotional and Motivational Aspects of Learning Experience.**

**Share the significance of integrating graphical representations as a key element in achieving success in the Bilingual Math Program.**



# Bilingual Math Class Workflow: Path to Mastery



Date \_\_\_\_\_

○What was not clear to you the most in today's class?

○What was the most important thing you learned today?

Knowledge				Ability to Explain				Attitude			
A	B	C	D	A	B	C	D	A	B	C	D

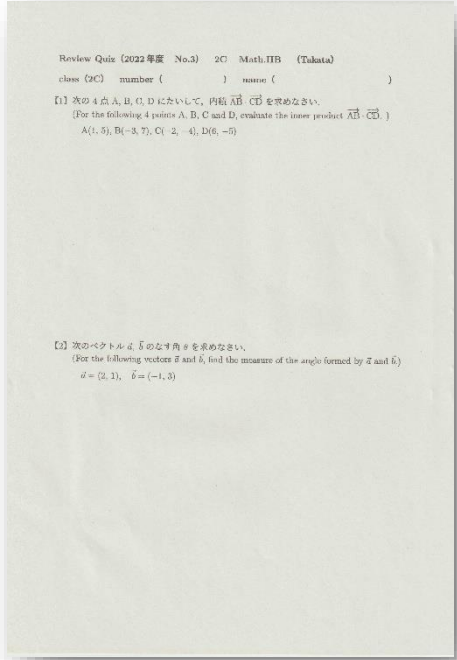
**Structured form of group work to solve Math Problems**  
 (Cooperative Learning Activity)

**Bilingual Lecture**

**Student Learning Reflection**

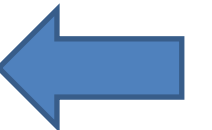
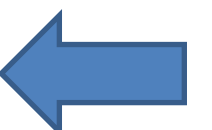
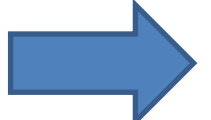
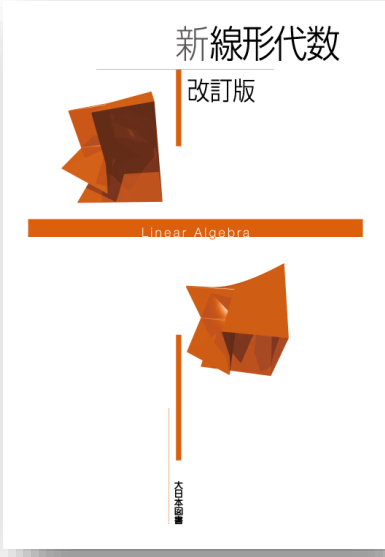
**Next Lesson**

**Lesson Quiz**



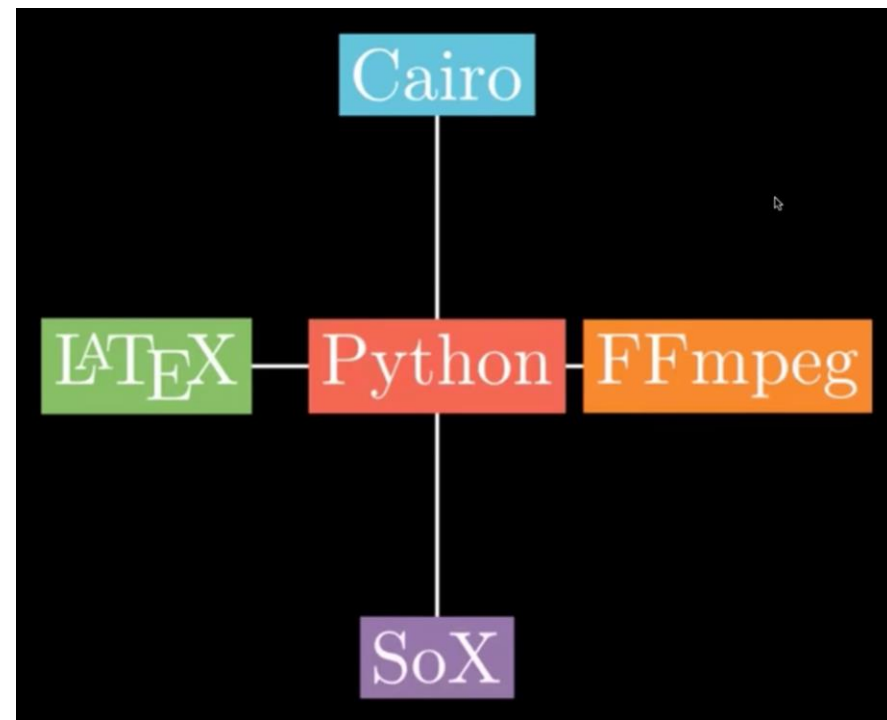
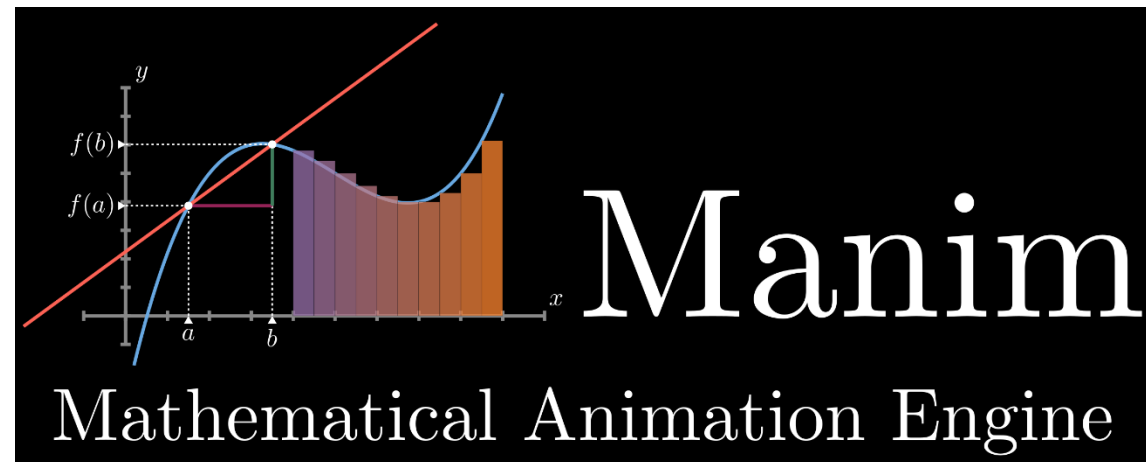
**Address Student Questions and Discuss Learning Reflections**

**Lesson Homework**

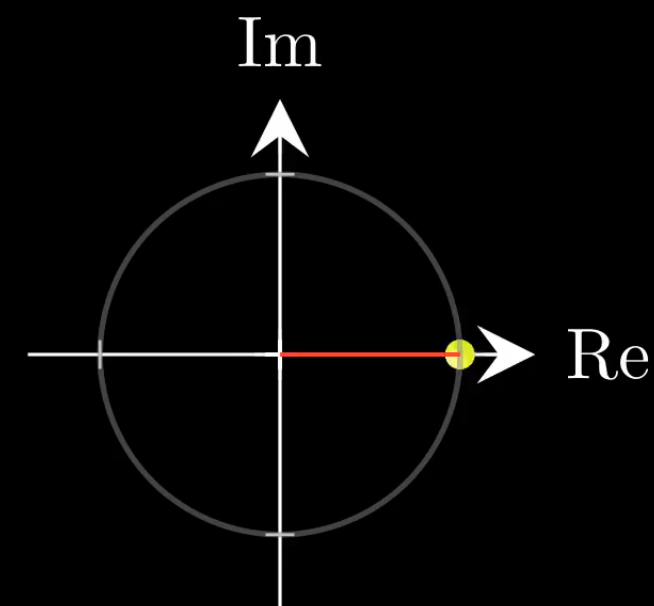


# Harnessing the Power of Graphic Calculators: A Key to Success in the Math Bilingual Education Program at NITAC

## Graphic Tools:



### Euler's formula

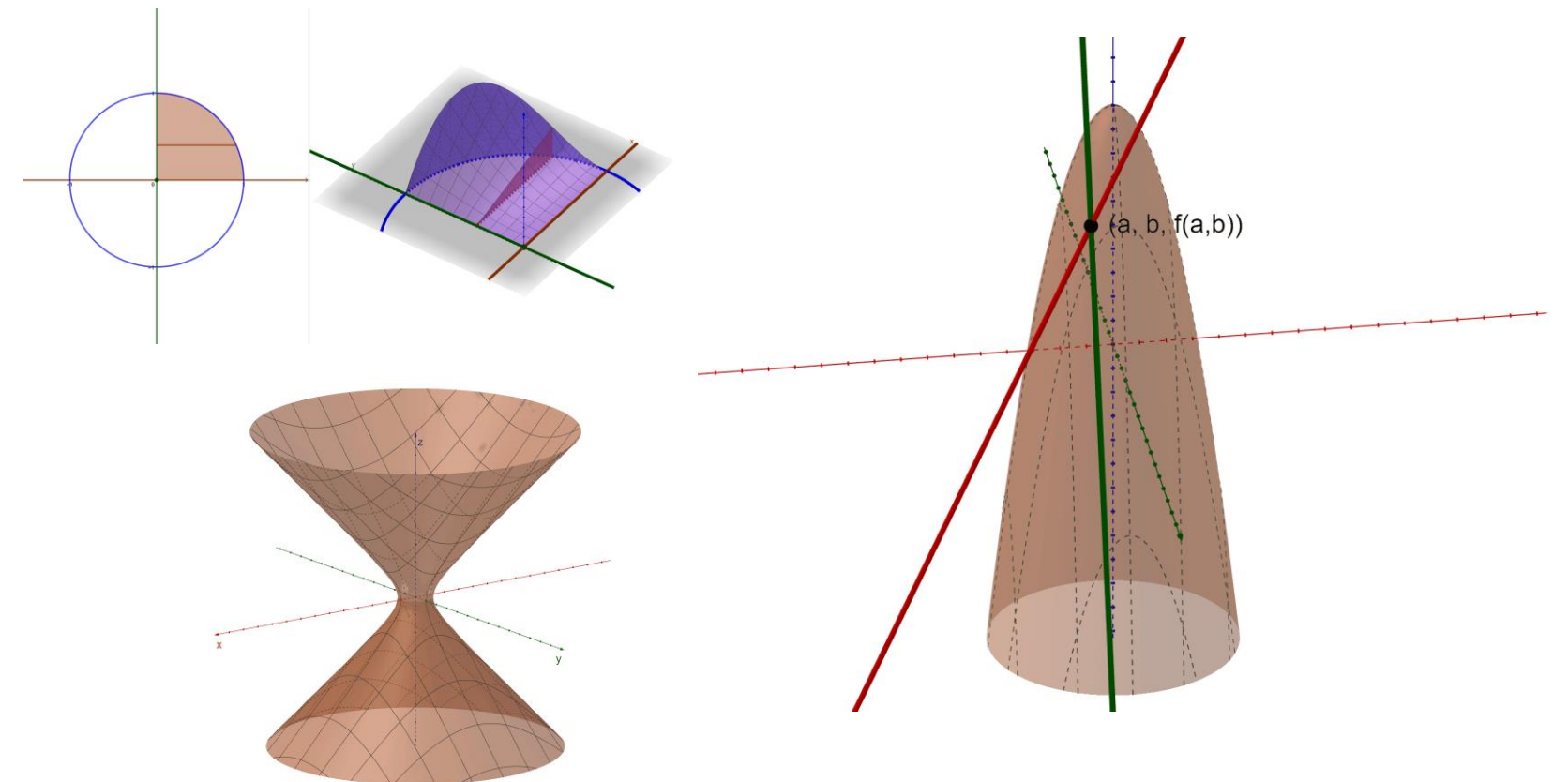
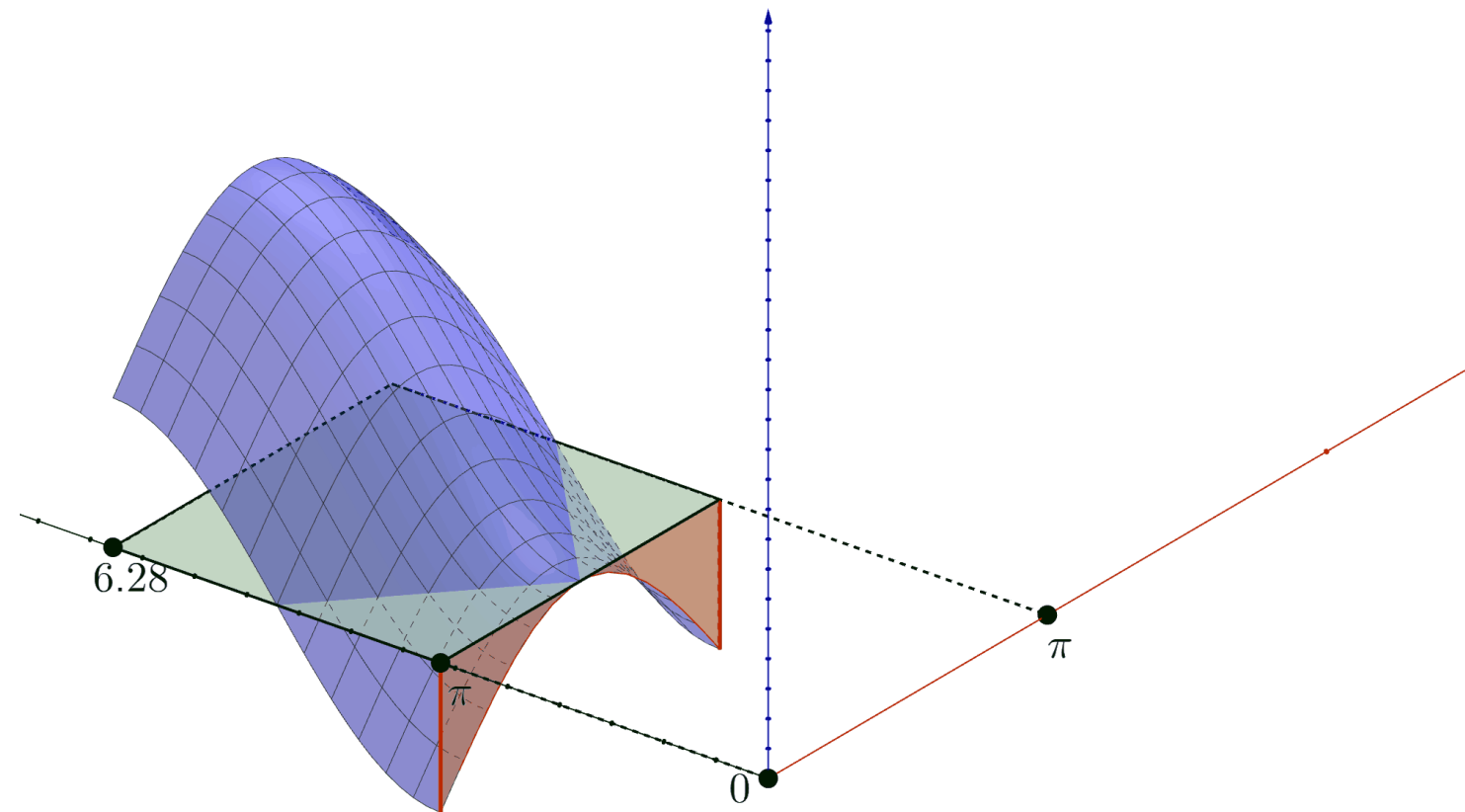
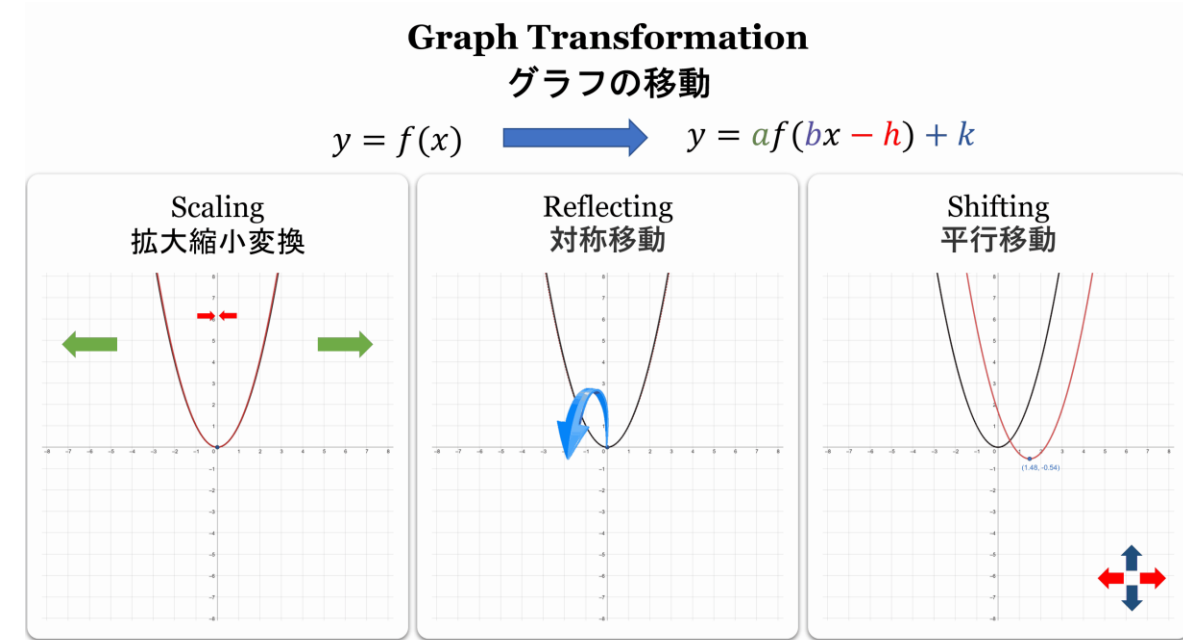
$$e^{j\theta} = \cos \theta + j \sin \theta$$


The diagram shows a complex plane with a horizontal real axis (Re) and a vertical imaginary axis (Im). A unit circle is centered at the origin. A red arrow points from the origin to a yellow dot on the positive real axis, representing the complex number 1. The axes are labeled 'Im' and 'Re'.

# Harnessing the Power of Graphic Calculators: A Key to Success in the Math Bilingual Education Program at NITAC

Graphic Tools:

# GeoGebra



[Link:3D Calculator - GeoGebra](#)





# Volume over a Rectangular Region



# Evaluation of the Math Bilingual Program

1

## Program Components

- Achievement of lesson objectives
- Quality of the content of the bilingual lessons
- Performance of the teacher
- Quality of teaching materials, and sufficiency of time allocation

2

Effects on the Student  
Math performance and  
capabilities in the class

3

Emotional and  
Motivational aspects of  
learning experience

# Program Components

- Achievement of lesson objectives
- Quality of the content of the bilingual lessons
- Performance of the teacher
- Quality of teaching materials, and sufficiency of time allocation

**Link:** <https://forms.office.com/r/RcbE3XX4nZ>

**Bilingual Lesson Evaluation and Feedback Form**  
2nd Sem SY 2022-2023

**(バイリンガル授業に関する評価フォーム)**

This form aims to gather students' and observers' evaluation and feedback about the effectiveness of the Bilingual Mathematics Program in conducting bilingual lessons in the Math Classes of St. Leo's Tokyo. The will help the monitor (Kazu Sensei) provide better lesson presentations for the next semester. All responses to this form will be kept confidential.

このフォームは、高田先生の数学の授業で実施する「バイリンガル授業」の有効性に関する評価とフィードバックを収集することを目的としています。これは、メンターであるKazu先生が次の学期に向けてより良い授業をすることを目指しています。このフォームでは、大田先生からの評価が漏れることはありませんので、ご安心ください。

Required

**Demographics (学年・クラス)**

Please provide the following demographic information for analysis purposes.  
分析のために、皆さんの情報を教えてください。

**1. Classifications (所属)**

1年生 (1st Grade)  
2年生 (2nd Grade)  
教員 (Teacher)  
どちらでもない (None)

**2. Class (for students only) (クラス (学生のみ))**

1M  
1E  
2A  
3C

Next Page 1 of 3

**Bilingual Lesson Evaluation and Feedback Form**  
1st Sem SY 2022-2023

**(バイリンガル授業に関する評価フォーム)**

Required

**3. Evaluation Form (評価表)**

Listed below are the statements about the target qualities of the Bilingual Lesson provided in your class. For each one, please indicate whether you strongly agree, agree, neutral, disagree or strongly disagree with it.  
(バイリンガル授業に関する以下の項目について、あなたの評価を教えてください。)

**3.1. Achievement of Objectives (目的の達成)**

The lesson objectives are clearly defined in each lesson.  
(バイリンガル授業の目的は、毎回明確に定義されている。)

Each bilingual lesson implementation help achieve or meet lesson objectives.  
(バイリンガル授業は、その目的を達成している。)

The topic in each lesson helps you to answer the problems in the review quizzes.  
(バイリンガル授業のトピックは、レビュークイズの問題に役立つのに役立つ。)

The teacher was able to meet the objectives of each bilingual lesson.  
(Kazu先生はバイリンガル授業の目的を達成することができた。)

**3.2. Content of the Bilingual Lessons (バイリンガル授業の内容)**

The content of each lesson covered was relevant to me.  
(バイリンガル授業の内容は私に役立つ。)

The content is organized and easy to follow.  
(内容は整理されており、簡単にフォローできる。)

**4. Performance of the Teacher (先生のパフォーマンス)**

The teacher was knowledgeable about the Math lessons.  
(Kazu先生は数学の授業に精通していた。)

The teacher was well prepared.  
(Kazu先生はよく準備していた。)

**4. Teaching Materials, Time, and Online Platform (教材、時間、オンラインプラットフォーム)**

The online materials (presentation files and English video lessons) distributed were helpful.  
(配布されたオンライン資料 (プレゼンテーションファイルと英語のビデオレッスン) は役に立った。)

The 15-30 minutes time allotted for the bilingual lesson was enough.  
(バイリンガル授業に割り当てられた (15-30分) 時間は十分であった。)

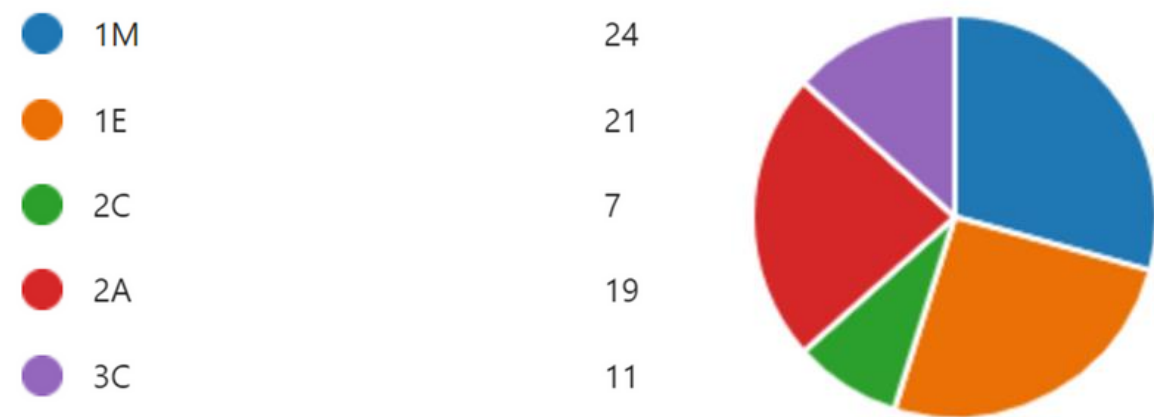
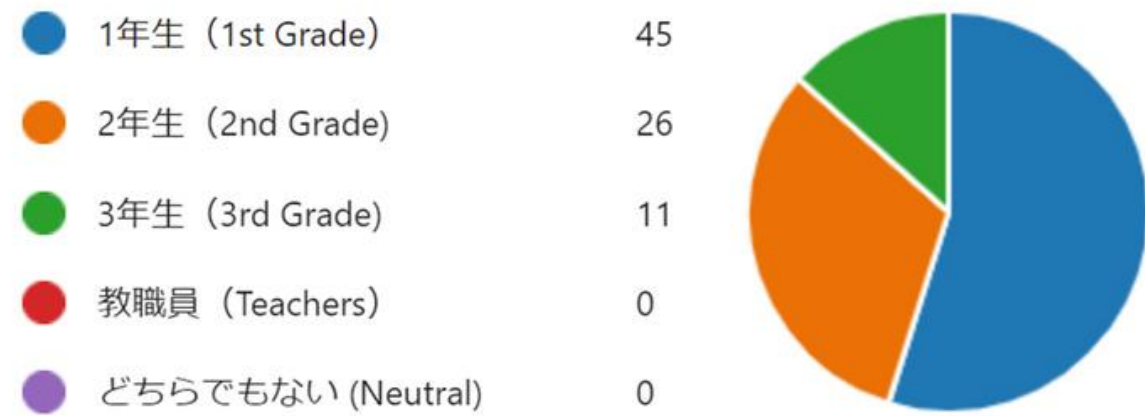
The online meeting platform (Zoom) is easy to access and effective for the bilingual class session.  
(バイリンガル授業に使用したZoomは、アクセスが簡単で、効果的なセッションとして効果的である。)

Agreement	Value
Strongly Disagree	0
Disagree	1
Neutral	2
Agree	3
Strongly Agree	4

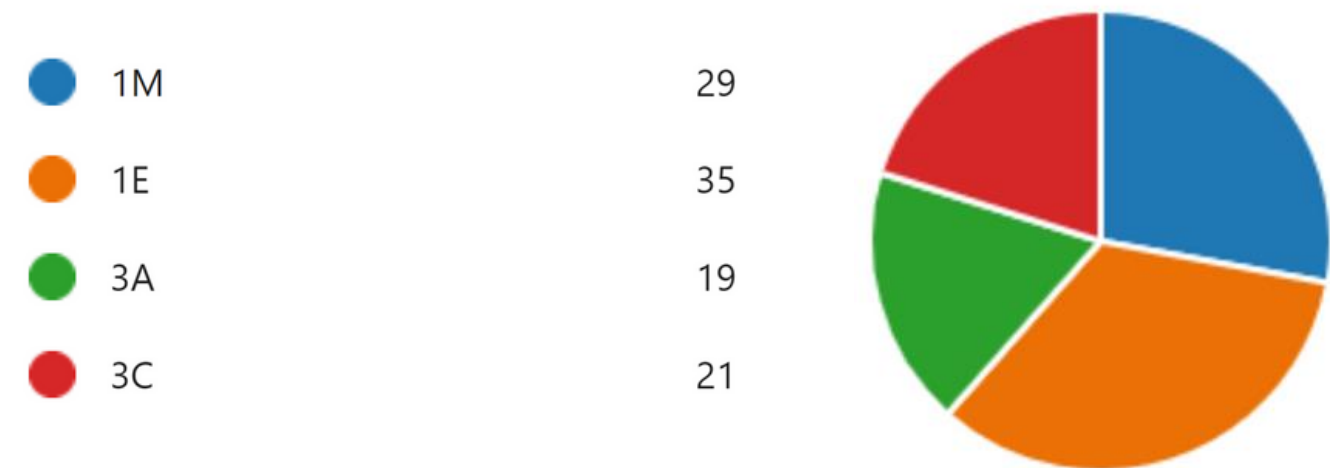
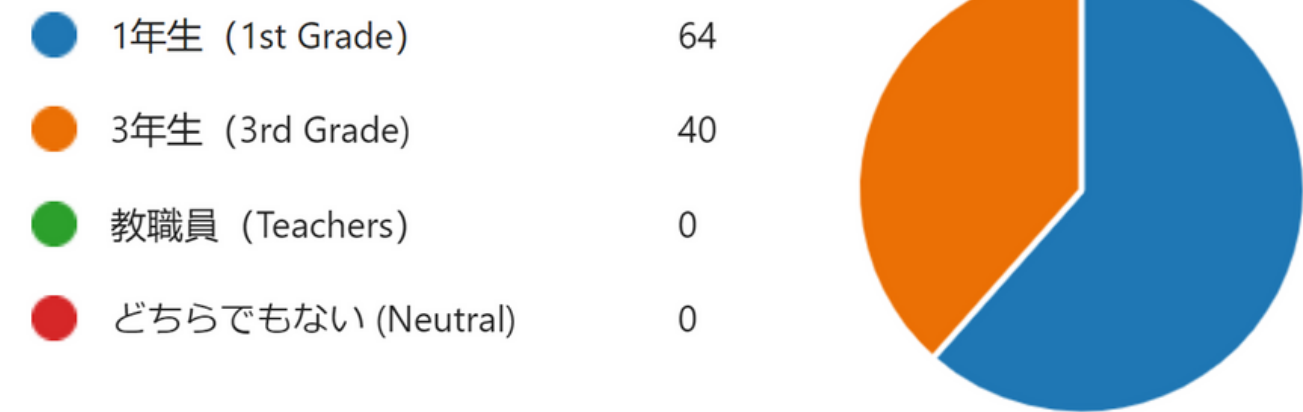
Quality	Range
Very Poor	0.00-0.80
Poor	0.81-1.60
Fair	1.61-2.40
Good	2.41-3.20
Excellent	3.21-4.00

# Program Components

## 1st Semester



## 2nd Semester



# Program Components

<b>Components</b>	<b>Mean Score</b>	<b>Quality Interpretation</b>
Achievement of Objectives (目的の達成)	3.24	Excellent
Content of the Bilingual Lessons (バイリンガルレッスンの内容)	3.26	Excellent
Performance of the Teacher (先生のパフォーマンス)	3.77	Excellent
Teaching Materials, and Time (トレーニング資料、時間)	3.30	Excellent
<b>Overall Mean</b>	<b>3.39</b>	<b>Excellent</b>

# Evaluation of the Math Bilingual Program

1

## Program Components

- Achievement of lesson objectives
- Quality of the content of the bilingual lessons
- Performance of the teacher
- Quality of teaching materials, and sufficiency of time allocation

2

## Effects on the Student Math Performance and Capabilities in the class

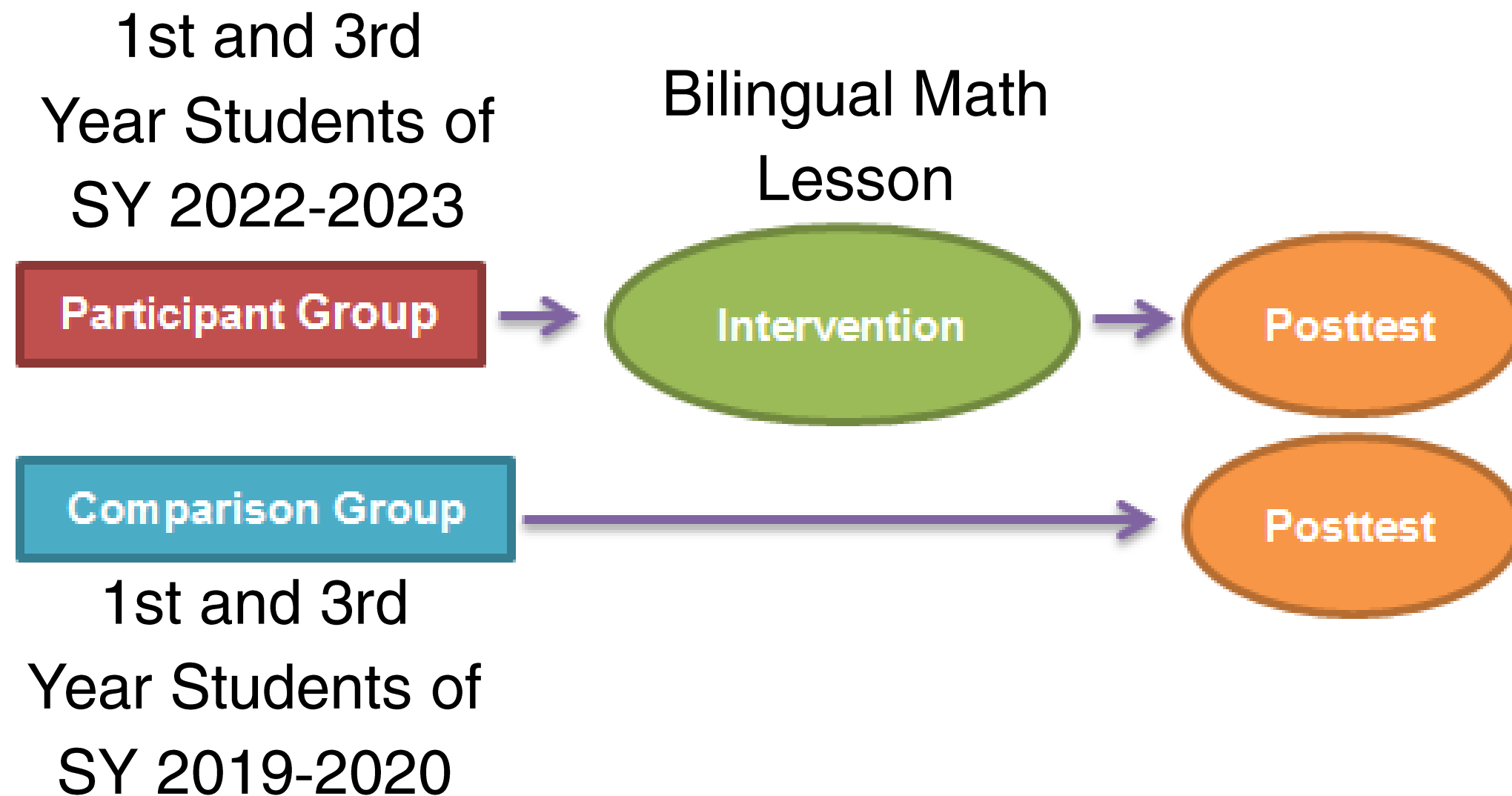
3

## Emotional and Motivational aspects of learning experience

# Objectives and Design

Determine the effects of the bilingual medium of instruction on the Mathematical performance, understanding, ability to explain, and attitude of NITAC Students in Mathematics subjects.

## Quasi-Experimental Research Design Post-Test Only Nonequivalent Group Design



- Math Performance
- Student Perception of their Knowledge, Ability to Explain, and Attitude in the class



# Definition of Terms

## Math Performance Quizzes

Review Quiz (2021年度 No.5) 2M Math.IIA (Takata)

class (2M) number ( ) name ( )

【1】 次の値を求めなさい。(Find the average rate of change.)

関数  $y = x^3 + 2x$  の  $a - h$  から  $a + 2h$  までの平均変化率

【2】 次の値を定義に従って求めなさい。

(Find the next differential coefficient according to a definition.)

$f(x) = \frac{1}{2x+1}$  の  $x = 1$  における微分係数

## Student Perception of their Knowledge, Ability to Explain, and Attitude in the class

RUBRIC:

	Knowledge	Ability to Explain	Attitude
Goal	Capable of understanding and calculating	Capable of giving explanation or stating your opinion	Be focused and actively engaged in the lesson.
Assessment	Displayed ability to understand and calculate	Explained the concepts, exercises or problems.	Showed focus and involvement in class.
A	I was able to understand all concepts, exercises, and problems.	I am able to explain all concepts, exercises and problems on my own.	I was focused, attentive, and/or actively involved during the lesson.
B	I was able to understand all concepts and calculate or solve problems with a little help.	I am able to explain all concepts, exercises and problems by referring to the notes.	I was focused, attentive and involved to a good extent.
C	There are concepts that I could not understand and problems or exercises that I could not solve or calculate.	There are concepts, problems or exercises that I cannot explain at all.	My focus, concentration, and/or involvement in class was very limited.
D	I was unable to understand the concepts, calculate exercises, nor solve the problems at all.	I am not able to explain the concepts, problems or exercises at all.	I was not able to focus or participate in class at all.

# Objectives and Problems

Determine the effects of the bilingual medium of instruction on the Mathematical performance, knowledge, ability to explain, and attitude of NITAC Students in Mathematics subjects.

## Questions:

1. What is the level of students' mathematical performance, perception of knowledge, ability to explain, and attitude according to the school year and grade level?
2. Is there a significant difference between the mathematical performance of the control and treatment groups at each year level?
3. Is there a significant difference between the student perception of their knowledge, ability to explain, and attitude of the control and treatment group in each grade level?



# Participants

Year Level (Course)	School Year (Group)	No. of Participants	Similar Lessons and Quizzes
First Year Level (1M and 1E)	2020-2021 (Control)	61	36 Lessons
	2022-2023 (Treatment)	57	
Third Year Level (3A)	2020-2021 (Control)	42	21 Lessons
	2022-2023 (Treatment)	38	

## SCALE

Levels of Knowledge,  
Ability to Explain,  
and Attitude (K-E-A) and  
Math Performance

Levels	Scale Range for K-E-A	Scale Range for Math Performance
High	3.01 - 4.00	4.01 - 6.00
Moderate	2.00 - 3.00	2.00 - 4.00
Low	1.00 - 1.99	0.00 - 1.99

# Statistical Tools

<b>Tools</b>	<b>Purpose</b>
<b>Mean</b>	To calculate the average performance, perception of understanding, ability to explain, and attitude of the control and treatment groups at each year level.
<b>Shapiro-Wilk Test</b>	<b>To test the normality of the data distribution of the control and treatment groups at each grade level.</b> It is used to check if the data meets the assumption of normality for parametric tests.
<b>Mann-Whitney U test</b>	<b>To determine if there is a significant difference between the medians of the control and treatment groups at each year level when the data is not normally distributed.</b> It is a non-parametric test that compares the medians of two independent samples.
<b>Independent Sample t-Test</b>	<b>To determine if there is a significant difference between the means of the control and treatment group in each grade level when the data is normally distributed.</b> It is a parametric test that compares the means of two independent samples.

# RESULTS

## Question

1. What is the level of students' mathematical performance, understanding, ability to explain, and attitude according to school year and grade level?

School Year	Groups	Knowledge		Ability to Explain		Attitude		Math Performance	
		Mean (Level)	SD	Mean (Level)	SD	Mean (Level)	SD	Mean (Level)	SD
1st Year (1M and 1E)	SY 2020-2021 (Control)	3.75 (High)	0.301	3.77 (High)	0.289	3.89 (High)	0.161	4.16 (High)	0.736
	SY 2022-2023 (Treatment)	3.70 (High)	0.336	3.59 (High)	0.409	3.82 (High)	0.318	4.36 (High)	0.608
3rd Year (3A)	SY 2020-2021 (Control)	3.27 (High)	0.634	3.33 (High)	0.672	3.63 (High)	0.528	3.73 (Moderate)	1.050
	SY 2022-2023 (Treatment)	3.32 (High)	0.487	3.30 (High)	0.576	3.66 (High)	0.413	3.30 (Moderate)	0.910

# RESULTS

## Test of Normality

### First Year Students

Group		Tests of Normality		
		Statistic	df	Sig.
Control	Knowledge	.805	61	.000
	Ability to Explain	.783	61	.000
	Attitude	.721	61	.000
	Performance	.930	61	.002
Treatment	Knowledge	.813	57	.000
	Ability to Explain	.871	57	.000
	Attitude	.639	57	.000
	Performance	.985	57	.690

Test of normality, specifically the Shapiro-Wilk Test, is used to determine if the data of the first year level violates the assumption of normality.

The result shows that **all the dependent variables** (Knowledge, Ability to Explain, Attitude, and Performance) **for both the control and treatment groups did not follow a normal distribution based on Shapiro-Wilk tests.**

However, the dependent variable of **Performance in the treatment group was found to have a significantly normal distribution** ( $W = 0.985$ ,  $p > 0.05$ ).

Due to the non-normal distribution of the other dependent variables, a non-parametric test was used.

# RESULTS

## Test of Normality

### Third Year Students

Group		Tests of Normality		
		Statistic	df	Sig.
Control	Knowledge	.873	42	.000
	Ability to Explain	.864	42	.000
	Attitude	.726	42	.000
	Performance	.962	42	.176
Treatment	Knowledge	.950	38	.088
	Ability to Explain	.923	38	.012
	Attitude	.767	38	.000
	Performance	.944	38	.055

The study conducted a Shapiro-Wilk test to determine whether the data gathered from the control and treatment groups in the third year level is normally distributed.

The results showed that for the **control group, all variables** (Knowledge:  $W=.873$ ,  $p < 0.05$ ; Ability to Explain:  $W = .864$ ,  $p < 0.05$ ; Attitude:  $W = .726$ ,  $p < 0.05$ ) **except Performance** ( $W=.962$ ,  $p > 0.05$ ) **were non-normally distributed.**

On the other hand, in the treatment group, **two variables** (Ability to Explain  $W=.923$ ,  $p < 0.05$  and Attitude  $W=.767$ ,  $p < 0.05$ ) **were significantly non-normally distributed**, while **two variables** (Knowledge  $W=.950$ ,  $p > 0.05$  and Performance  $W=.944$ ,  $p > 0.05$ ) **were normally distributed.**

Thus, the study used non-parametric tests for variables with significantly non-normal distribution and parametric tests for variables with normally distributed data.

# RESULTS

## Question

2. Is there a significant difference between the mathematical performance of the control and treatment groups in each year level?

### First Year Students

Performance	Ranks		
	Group	N	Mean Rank
	Control	61	56.36
	Treatment	57	62.86
	Total	118	

#### Test Statistics<sup>a</sup>

	Performance
Mann-Whitney U	1547.000
Wilcoxon W	3438.000
Z	-1.031
Asymp. Sig. (2-tailed)	.302

a. Grouping Variable: Group

A Mann-Whitney U test was performed to evaluate whether there is a significant difference between the mathematical performance of the control and treatment group.

The results indicated that there is no significant difference between the mathematical performance of the control and treatment group, ( $z = -1.031$ ,  $p > .05$ ).



# RESULTS

## Question

2. Is there a significant difference between the mathematical performance of the control and treatment groups in each year level?

### Third Year Students

		Group Statistics								
Performance		Group	N	Mean	Std. Deviation	Std. Error Mean				
	Control		42	3.7326	1.05959	.16350				
	Treatment		38	3.2963	.90899	.14746				

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Performance	Equal variances assumed	1.377	.244	1.966	78	.053	.43630	.22187	-.00541	.87802
	Equal variances not assumed			1.982	77.792	.051	.43630	.22017	-.00204	.87465

An independent sample t-test was conducted to determine the effects of bilingual lessons on student performance. Levene's test showed that variances were equal ( $F(1, 79) = 1.377, p > .05$ ), allowing for a t-test assuming homogeneity of variance.

The results showed **no significant difference in mean scores** between students who received bilingual lessons ( $\bar{x} = 3.2963$ ) and those who did not ( $\bar{x} = 3.7326$ ),  $t(78) = .053, p > .05$ . Therefore, it can be concluded that there is **no significant difference in performance between the two groups.**

# RESULTS

## Question

3. Is there a significant difference between the student perception of their understanding, ability to explain, and attitude of the control and treatment group in each grade level?

### First Year Students

		Ranks		
	Group	N	Mean Rank	Sum of Ranks
Knowledge	Control	61	61.68	3762.50
	Treatment	57	57.17	3258.50
	Total	118		
Ability to Explain	Control	61	65.89	4019.00
	Treatment	57	52.67	3002.00
	Total	118		
Attitude	Control	61	59.84	3650.50
	Treatment	57	59.13	3370.50
	Total	118		

Test Statistics <sup>a</sup>			
	Knowledge	Ability to Explain	Attitude
Mann-Whitney U	1605.500	1349.000	1717.500
Wilcoxon W	3258.500	3002.000	3370.500
Z	-.723	-2.118	-.118
Asymp. Sig. (2-tailed)	.470	.034	.906

a. Grouping Variable: Group

A Mann-Whitney U test was performed to evaluate whether there is a significant difference between the Mathematical understanding, ability to explain, and attitude of the control and treatment group of first year students.

The results indicated that there is **no significant difference between the self evaluation of knowledge** ( $z = -.723, p > 0.05$ ), **and attitude** ( $z = -.118, p > 0.05$ ) of the control and treatment group.

However, the results showed that **the control group had a significantly higher self-evaluation of their ability to explain than the bilingual class group** ( $z = -2.118, p < 0.05$ ).



# RESULTS

## Question

3. Is there a significant difference between the student perception of their understanding, ability to explain, and attitude of the control and treatment group in each grade level?

## Third Year Students

	Ranks			Sum of Ranks
	Group	N	Mean Rank	
Knowledge	Control	42	40.56	1703.50
	Treatment	38	40.43	1536.50
	Total	80		
Ability to Explain	Control	42	42.10	1768.00
	Treatment	38	38.74	1472.00
	Total	80		
Attitude	Control	42	40.75	1711.50
	Treatment	38	40.22	1528.50
	Total	80		

	Test Statistics <sup>a</sup>		
	Knowledge	Ability to Explain	Attitude
Mann-Whitney U	795.500	731.000	787.500
Wilcoxon W	1536.500	1472.000	1528.500
Z	-.024	-.651	-.108
Asymp. Sig. (2-tailed)	.981	.515	.914

a. Grouping Variable: Group

A Mann-Whitney U test was performed to evaluate whether there is a significant difference between the student perception on their Mathematical understanding, ability to explain, and attitude of the control and treatment group of third year students.

The results indicated that there is **no significant difference between the self-evaluation of their knowledge** ( $z = -.024, p > .05$ ), **ability to explain** ( $z = -.651, p > .05$ ), and **attitude** ( $z = -.651, p > .05$ ) of the control and treatment group.

# Summary and Conclusion

Determine the effects of the bilingual medium of instruction on the Mathematical performance, understanding, ability to explain, and attitude of NITAC Students in Mathematics subjects.

<b>Questions</b>	<b>Answers</b>
1. What is the level of students' mathematical performance, perception of knowledge, ability to explain, and attitude according to the school year and grade level?	The control and treatment groups of the first-grade students have high level of self-evaluation of their knowledge, ability to explain, attitude and Math performance.  The control and treatment groups of the third-grade students have high level of self-evaluation of their knowledge, ability to explain, attitude and moderate level of Math performance.
2. Is there a significant difference between the mathematical performance of the control and treatment groups at each year level?	There is no significant difference between the mathematical performance of the control and treatment groups in both year levels. Hence, the program has no negative effect on their math performance.

# Summary and Conclusion

Determine the effects of the bilingual medium of instruction on the Mathematical performance, understanding, ability to explain, and attitude of NITAC Students in Mathematics subjects.

<b>Questions</b>	<b>Answers</b>
3. Is there a significant difference between the student perception of their knowledge, ability to explain, and attitude of the control and treatment group in each grade level?	<p>There is no significant difference between the level of self-evaluation of knowledge, and attitude of the control and treatment group of first year students. However, the control group had a significantly higher self-evaluation of their ability to explain than the bilingual class group.</p> <p>There is no significant difference between the level of self-evaluation of knowledge, ability to explain, and attitude of the control and treatment group of third year students. Hence, the program has no negative effect on their self-evaluation of their KEA.</p>

# Evaluation of the Math Bilingual Program

1

## Program Components

- Achievement of lesson objectives
- Quality of the content of the bilingual lessons
- Performance of the teacher
- Quality of teaching materials, and sufficiency of time allocation

2

## Effects on the Student Math Performance and Capabilities in the class

3

## Emotional and Motivational aspects of learning experience

# Emotional and Motivational aspects of learning experience

Gather feedback from students about the Math Bilingual Program and identify areas for improvement.

- 1. Evaluate students' level of excitement towards Math lessons discussed in both English and Japanese, and gather reasoning behind their answer.**
- 2. Identify the positive aspects and pinpoint areas that need improvement of the Math Bilingual Lessons from students' perspective.**
- 3. Gather suggestions on what else can be included in the Bilingual Math Class from students' perspective.**
- 4. Determine the likelihood of students recommending the Bilingual Math Classes to their schoolmates, and gather reasoning behind their answer.**

**Link:** <https://forms.office.com/r/RcbE3XX4nZ>

Bilingual Lesson Evaluation and Feedback Form  
1st Sem SY 2022-2023  
(バイリンガル授業に関する評価フォーム)

\* Required

Feedback Form (フィードバックフォーム) (7a)

Please answer the following questions: (以下の質問にお答えください。)

7  
Do you find Math lessons discussed both in English and Japanese exciting? Yes/No?  
(英語と日本語の両方で講義されている数学の授業は楽しいと思えますか? はい・いいえ。)\*

Yes (はい)

No (いいえ)

8  
Please explain your answer in item 7.  
(質問7について、その答えの理由を教えてください。)\*

Enter your answer

9  
What did you like most about the Math Bilingual Lessons?  
(バイリンガル授業の何が一番好きでしたか?)\*

Enter your answer

10  
What aspects of the Mathematics Bilingual lessons could be improved?  
(バイリンガル授業のどの側面を改善できると思いますか?)\*

Enter your answer

11  
What else would you like to see to be included in this bilingual Math class?  
(このバイリンガル授業に他に何が含まれると良いと思えますか?)\*

Enter your answer

12  
Would you recommend attending bilingual math classes to your schoolmates? Yes/No.  
(バイリンガル授業を受けていない友人にバイリンガル授業への参加を勧めたいと思えますか? はい・いいえ。)\*

Yes (はい)

No (いいえ)

13  
Please explain your answer in item 12.  
(質問12について、その答えの理由を教えてください。)\*

Enter your answer

14  
Any other comments?  
(他にコメント等あれば自由に記述してください)

Enter your answer

Send me an email receipt of my responses

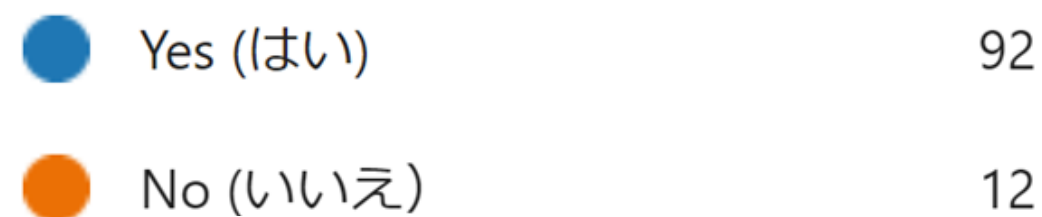
Back Submit Page 2 of 3



# RESULTS

**1. Evaluate students' level of excitement** towards Math lessons discussed in both English and Japanese, and gather reasoning behind their answer.

Do you find Math lessons discussed both in English and Japanese exciting? Yes/No?  
Explain your answer.



- **Most students find the bilingual math lessons exciting and helpful for understanding math concepts.**

"楽しかった" (*It was fun.*)

"日本語のみの数学では退屈だと思ふときがあるから。海外の考え方や解法が反映されていて面白いから。" (*Sometimes, I find studying math in Japanese alone boring. It's interesting to see the perspectives and problem-solving approaches used in other countries.*)

"理解が深まる" (*My understanding deepened.*)

"日本語と英語で2度説明を聞けるので理解が深まる" (*I can deepen my understanding by hearing explanations in both Japanese and English.*)

"数式を見たら言ってる意味が理解できるので、同時に英語を聞くとなんとなく英語の方も理解できて楽しかった" (*When I saw the formula, I could understand the meaning of what was being said, so it was fun to understand the English as well.*)

# RESULTS

**1. Evaluate students' level of excitement** towards Math lessons discussed in both English and Japanese, and gather reasoning behind their answer.

Do you find Math lessons discussed both in English and Japanese exciting? Yes/No?  
Explain your answer.



- **The bilingual approach helps some students to improve their language skills and learn about different approaches to math from different cultures**

英語の表現が学べるから (Because you can learn English expressions)

英語も学べて一石二鳥だから (Because you can learn both English and math)

日本語の数学用語を英語で聞けるから (Because you can hear math terms in Japanese and English)

数学の単語や言い方を英語でどのように言うかが身についたから。(Because you learn how to say math words and phrases in English)

海外の考え方や解法が反映されていて面白いから。(Because different approaches and methods from different cultures are interesting)

英語に親しみながら理解できるから (Because you can understand while becoming familiar with English)

多言語で学ぶことによって英語の勉強にもなるから (Because learning in multiple languages can also help with English study)

# RESULTS

## 1. Evaluate students' level of excitement towards Math lessons discussed in both English and Japanese, and gather reasoning behind their answer.

Do you find Math lessons discussed both in English and Japanese exciting? Yes/No?  
Explain your answer.

● Yes (はい)

● No (いいえ)



### • However, some students struggle with understanding math concepts in English and find the bilingual approach time-consuming.

92

解けないから。(Because I can't solve it.)

12

知っている単語や知らない単語が飛び交う中で、数学も理解しないといけないのが少ししんどかったが、楽しい時もあった。(It was a bit tiring to understand math concepts while dealing with known and unknown words, but sometimes it was enjoyable.)

英語がわからない (I don't understand English.)

時間が2倍かかることになるため。(It takes twice as much time.)

英語が難しい (English is difficult.)

スライドがあるので英語がわからない部分も理解できた。日本語は掻い摘むだけで良いと思う。(I could understand even the parts of English that I didn't understand because of the slides. I think it's enough to just skim through the Japanese.)

スライドが理解しやすいのでなんとなっているが、英語だけの授業であれば理解できていなかったと思う。(I could understand because the slides were easy to understand, but I don't think I could have understood if it was only an English class.)

説明があまりわからないことがあっても、かわりに図や式がとてもわかりやすく整理されていることが多いので (Even if I didn't understand some of the explanations, there were many times when the diagrams and formulas were very clear and well-organized.)

For me I am a international student so it is so helpful for me to understand the lessons. (For me as an international student, it's helpful to understand the lessons.)

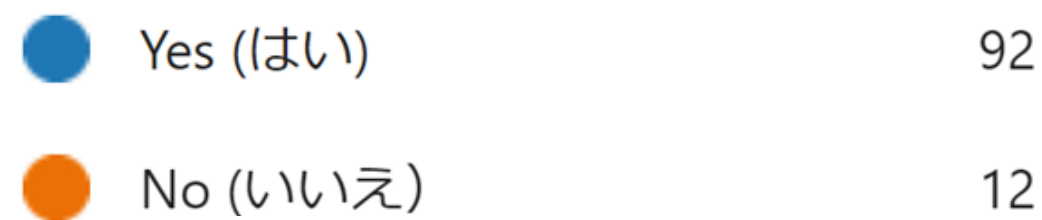
数式について英語で説明されたあと日本語で説明され... (After the formulas were explained in English, they were explained again in Japanese...)



# RESULTS

**1. Evaluate students' level of excitement** towards Math lessons discussed in both English and Japanese, and gather reasoning behind their answer.

Do you find Math lessons discussed both in English and Japanese exciting? Yes/No?  
Explain your answer.



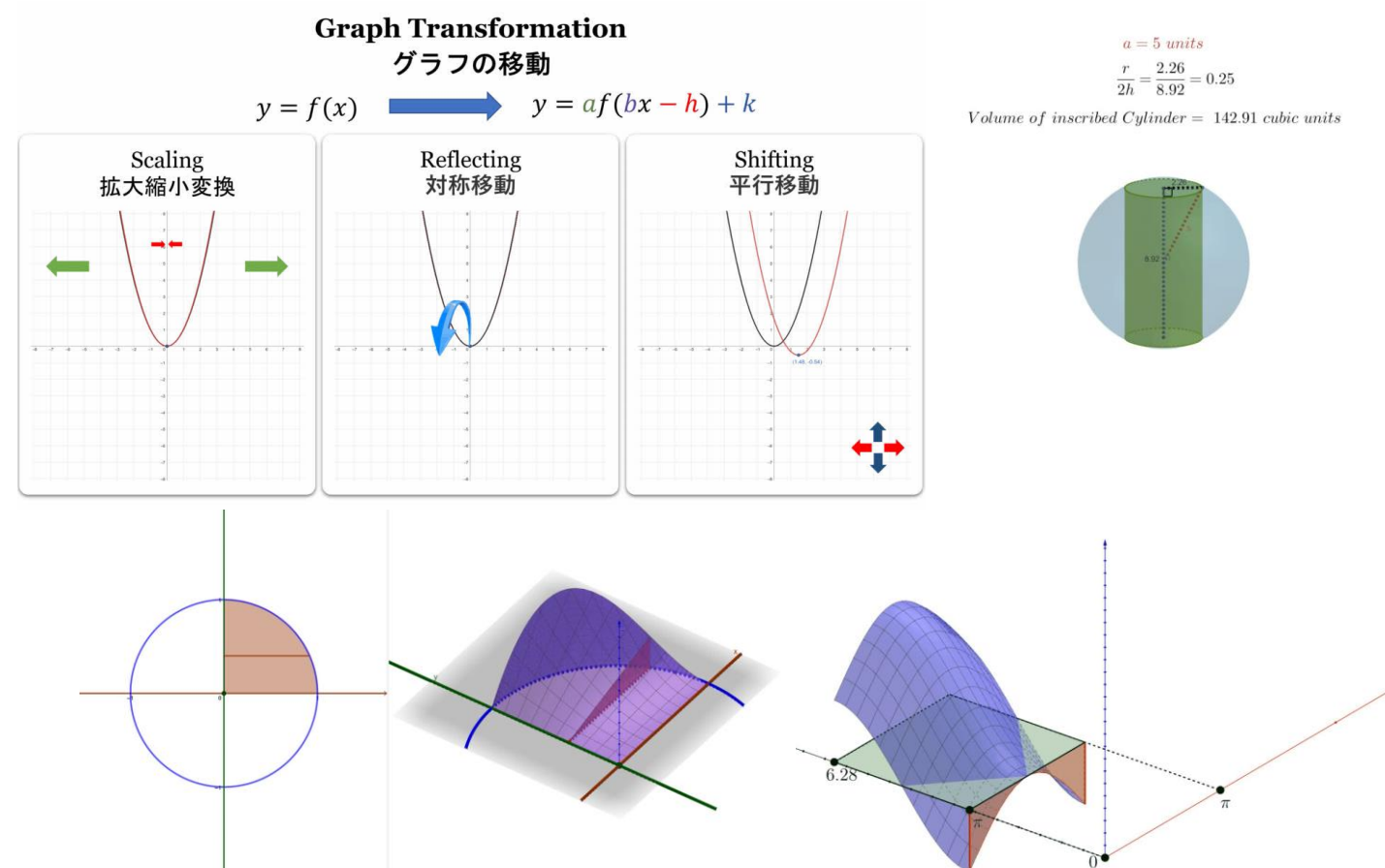
- **Overall, the bilingual math program has a positive impact on students' motivation and understanding of math concepts.**
- **Negative feedback is often related to students' proficiency in English.**
- **To ensure all students benefit from the program, additional support may be necessary for those who are struggling with the language aspect of the bilingual lessons.**

# RESULTS

## 2. Identify the positive aspects of the Math Bilingual Lessons from students' perspective.

What did you like most about the Math Bilingual Lessons?

- **Students appreciated the use of slides, clear explanations, and visuals/graphs to understand difficult concepts.**



"スライドがわかりやすいこと。特に、図形の問題は、スライドだとよく理解できました。" (The slides are easy to understand. Especially for geometry problems, I could understand them well with the slides.)

"作りこまれたスライド。" (Well-crafted slides.)

"英語での解説と日本語での解説を行ってくれること。" (Providing explanations in both English and Japanese.)

"スライドでしっかりと細かく解説される場所" (Detailed explanations using slides)

"ケビン先生のスライドが何通りもの考え方を提示してくれてわかりやすかったです" (Kevin's slides presented multiple ways of thinking, which made it easy to understand.)

"わかりやすいスライド" (Easy-to-understand slides)

"GeoGebraで、3次元のグラフをわかりやすくしてくれていたこと。" (Using GeoGebra to make 3D graphs easy to understand.)

# RESULTS

## 2. Identify the positive aspects of the Math Bilingual Lessons from students' perspective.

What did you like most about the Math Bilingual Lessons?

- **Students enjoyed explanations in both Japanese and English, which helped them understand the material better.**

"I can understand both Japanese and English."

"英語での解説と日本語での解説を行ってくれること。" (Provide explanations in both English and Japanese.)

"英語を含めた分かりやすいスライドを見ること" (Experience easy-to-understand slides that include English.)

"ケビン先生と高田先生の絡みが微笑ましいというか、面白かったです。" (The interaction between Kevin-sensei and Takata-sensei was heartwarming or rather, entertaining.)

"先生が解説してくれること。" (The teacher provides explanations.)

"ケビン先生の解法" (Kevin-sensei's solution method.)

"わかりやすいスライド" (Easy-to-understand slides.)

"英語で授業が受けれるところ" (A place where classes can be taken in English.)

"日本ではメジャーでない解き方が知れること" (Being able to learn non-major methods of solving problems in Japan.)

# RESULTS

## 2. Identify the positive aspects of the Math Bilingual Lessons from students' perspective.

What did you like most about the Math Bilingual Lessons?

- **Different perspectives and problem-solving approaches offered by the two teachers were helpful.**

*"I can listen to the explanation twice. Kevin sensei and Takata sensei have different perspectives and ways of solving the same question. After Kevin sensei explained his way of solving, Takata sensei may provide a different way of solving. As a student, I have more options when choosing how to solve the question."*

- **Interesting stories and anecdotes, use of humor and jokes, and opportunity to learn new concepts and vocabulary were positive aspects.**
- **Overall, the Math Bilingual Lessons were a success, and students benefited greatly from them.**

# RESULTS

## 2. Pinpoint areas that need improvement of the Math Bilingual Lessons from students' perspective.

What aspects of the Mathematics Bilingual lessons could be improved?

Based on their comments, here are some suggestions for improving the Mathematics Bilingual lessons:

- Reduce the time spent on translation
- Increase lecture time
- Provide more detailed translations
- Start explanations earlier
- Improve the pace of the lessons
- Create an English vocabulary list
- Provide more opportunities for questions
- Create an English version of Moodle

# RESULTS

## 3. **Gather suggestions on what else can be included** in the Bilingual Math Class from students' perspective.

What else would you like to see to be included in this bilingual Math class?

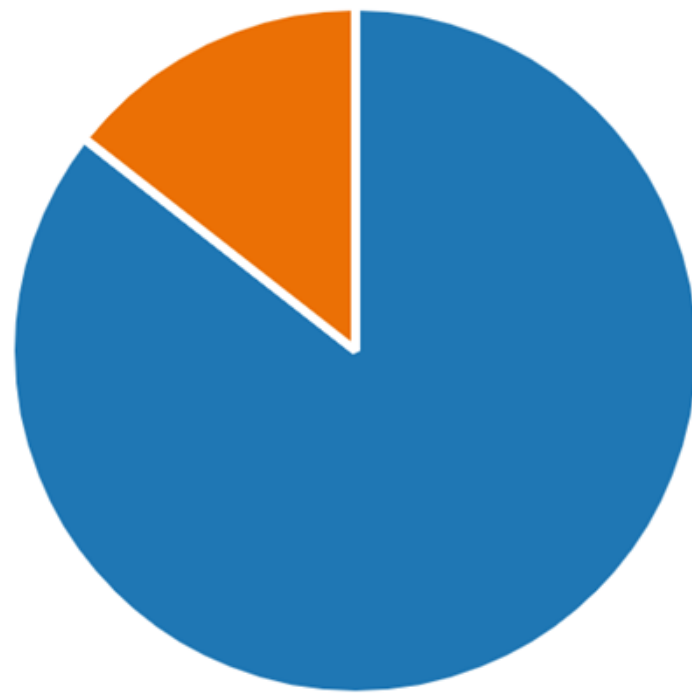
- Some students are satisfied with the current state of the bilingual Math class.
- Suggestions for additional activities include:
  - Solving simple equations in English
  - Reducing Japanese assistance gradually
  - Quizzes and group work in English
  - More active learning through lesson gamification
  - Speeches in English
  - History of Math Concepts
- Some students want more explanations in English and English subtitles.
- Others suggested having Japanese translations on slides.
- A few students requested more communication with the teacher in English and more challenging content.
- Some students did not provide any additional feedback or were unsure.



# RESULTS

4. **Determine the likelihood of students recommending** the Bilingual Math Classes to their schoolmates, and gather reasoning behind their answer.

Would you recommend attending bilingual math classes to your schoolmates? Yes/No? Why?



- Majority of Japanese students surveyed found bilingual math classes enjoyable and beneficial.
- Students would recommend attending bilingual math classes to their schoolmates.
- Reasons cited for recommending bilingual math classes include the opportunity to learn English, understanding math concepts in both Japanese and English, the importance of English in a global society, learning math from a different perspective, and the unique experience being interesting and fun.
- Some students found learning math in English challenging and preferred studying math in Japanese.

# RESULTS

4. **Determine the likelihood of students recommending** the Bilingual Math Classes to their schoolmates and gather reasoning behind their answer.

Any other comments

「偏微分や重積分では3次元での図形を扱うことになり、それらがどのような形をしているかイメージがしづらかったのですが、スライドがとても見やすく、どこをどのように計算しているのか、式の意味が分かり、深い理解に繋がりました」

*"In partial differentiation and multiple integration, we deal with three-dimensional figures, and it was difficult for me to visualize what shape they take. However, the slides were very clear and easy to understand. They showed where and how to perform the calculations, and I could grasp the meaning of the equations, leading to a deeper understanding."*

The feedback from the students indicates a positive experience overall. They appreciated the opportunity to learn and deepen their understanding of math concepts. *The interactive tools, which allowed them to see how changing numerical values affected the graphs, were particularly helpful and interesting.* The clear explanations of the teachers and approachable teaching style were also noted as positives, despite the class being conducted in English, which some students found challenging at first but eventually enjoyable. Overall, the students expressed gratitude for the teachers' efforts and hoped to continue learning from them in the future.



# Evaluation of the Math Bilingual Program

1

## Program Components

- Achievement of lesson objectives
- Quality of the content of the bilingual lessons
- Performance of the teacher
- Quality of teaching materials, and sufficiency of time allocation

2

## Effects on the Student Math Performance and Capabilities in the class

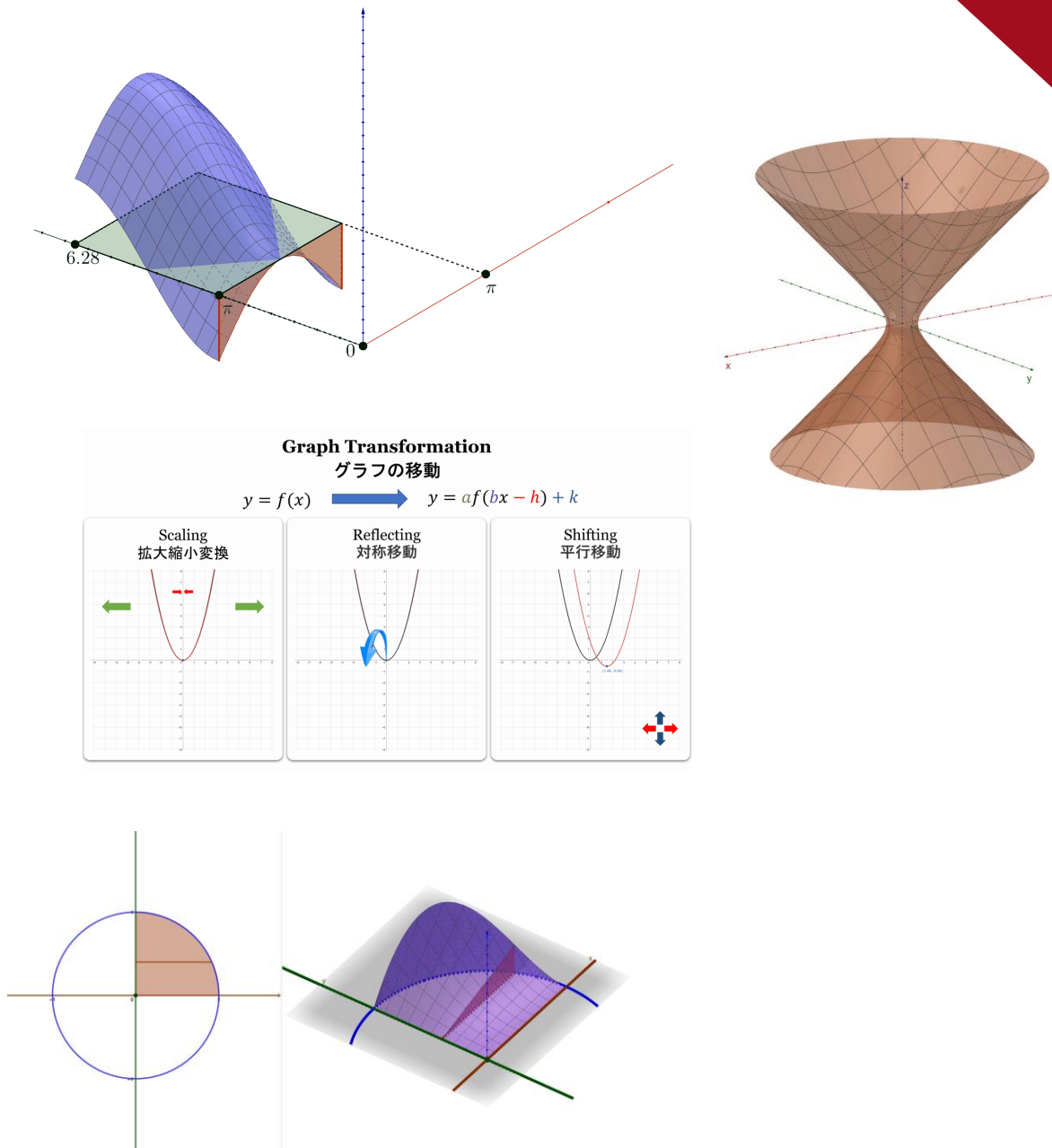
3

## Emotional and Motivational aspects of learning experience



NATIONAL INSTITUTE OF TECHNOLOGY  
AKASHI KOSEN COLLEGE JAPAN  
明石工業高等専門学校  
GLOBAL EDUCATION CENTER  
グローバルエデュケーションセンター

# Harnessing the Power of Graphic Calculators: A Key to Success in the Math Bilingual Education Program at NITAC



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