

## Professional Development Report for Mathematics

### Rationale

The Education Sector of Tsirang Dzongkhag organized “Mathematics Professional Development Workshop” with the Project Tigt Assistant (PTA), GoI, with support from Teacher Professional Support Division (TPSD) under Ministry of Education. The overarching theme for the Professional Development was “*Improving learning outcome through the development of teachers’ competency.*” The workshop intended, to include,

- Inquiry-based learning
- Multiple Solutions
- Manipulative
- Problem-Solving skills
- Problem Based Learning
- Mathematics using ICT

Workshop for three clusters; Tsirangtoe, Mendrelgang and Damphu was facilitated by Mr. Yeshi (DMSS), Mr. Sangay Kinzang (DMSS) and Mr. Damchoe Yezer (TCS) respectively.

### Introduction

The Mathematics Professional Development Workshop for Teachers on strategies to improve the Mathematical performance took place from 25<sup>th</sup> October to 4<sup>th</sup> November 2020. The workshop began in Tsirangtoe Central School on the 25<sup>th</sup> of October and ended in Damphu Central School on the 4<sup>th</sup> of November. The schedule was as follows:

25<sup>th</sup> October – 28<sup>th</sup> October: Tsirangtoe Central School

29<sup>th</sup> October – 31<sup>st</sup> October: Mendrelgang Central School

1<sup>st</sup> November – 4<sup>th</sup> November: Damphu Central School

The number of participants:

School	Male	Female	Total
Tsirangtoe Central School	12	2	14
Mendrelgang Central School	11	6	17
Damphu Central School	16	6	22
Total	39	14	53



**Venue: Tsirangtoe Central School**

### **Day 1, Session 1, Introducing the session with interpretation of image**



The first session of the three days mathematics professional development program started with a two to three minutes of mindful meditation. This was done to calm the minds of the participants and grab their attention.

Introduction plays a vital role in capturing the student's attention and making them curious about what they are going to learn. The strategy was introduced through the interpretation of an open-ended image.

Different teachers had different opinions on what the picture could entail with the universal interpretation being the diagram represented the constructivist view of learning.



## Background:

Before we could start with the professional development program, it was important for the participating teachers to know the state of mathematics performance in the Tsirang dzongkhag. They needed to know why the professional development program was being conducted, so to give them a goal, to inform them what the PD looks to accomplish, a brief background of Dzongkhag achievement summary including academic learning score, proportion achievement and the pass percentage was presented to the teachers. Upon seeing the low academic score and the low number of proportion students, the teachers were very much worried and were eager to participate.



Sl. No	Class	% of students who scored more than 50%
1	VI	39.65/45
2	X	27/42

Activity: What could be the possible reason students score low marks in mathematics?



A brief background of the educational state in Tsirang was presented, and the big question now was why were the students not scoring good marks in Mathematics? Rather

than give them generic reasons, the question was thrown to the teachers and using their years of experience in teaching mathematics, they came up with various reasons, to include few,

- Teacher competency
- Myth/ Stigma
- Lack of practice
- Reading habits
- Lack of parental support

The teachers came up with numerous reasons, and the next part was just presenting what they had discussed concisely. This was made possible by focusing on what the curriculum expects from the teachers.

This intention is found in the first pages of every mathematics textbook, yet it was no surprise that many had not gone through the intentions of the curriculum. To make them familiar and curious about what the curriculum



intentions are, a diagram was shown and each intention was explained briefly. The intentions are detailed and expect a lot from the teachers, yet there is a big gap between implementation and intentions. Most of what is expected is thwarted by the bulky syllabus, systematic old-style teaching, the large number of students in a class, stigma against mathematics and the time constraint.

### **Strategies**

The why question was followed by how part. How to address, so that the students can learn mathematics meaningfully, interacting, and communicating mathematically ultimately

endure learning and perform better in their examinations. What are the strategies recommended by experts for the better learning of math? The answer was what the professional development program is all about and the first of many strategies were covered on the first day.

The strategies on the first day included:

- Inquiry-based learning
- Modelling and multiple solutions
- Use of manipulative



## Inquiry-based learning (IBL)

The first strategy was inquiry-based learning. A detailed explanation along with questions,



discussion about IBL was carried out. These includes its definition, the advantages of using it, the roles teachers play in implementing IBL, the types of IBL, the steps that should be followed in implementing IBL and finally the four pillars of IBL

in mathematics. The session covered the basic understanding of IBL and not the specific implementation in a mathematics classroom. The teachers displayed immense interest in the strategy as it was something very relevant and usable in a mathematics classroom.

## Session 2

To show the teachers, a basic understanding of what inquiry-based learning expects from the teachers, a video of real classroom teaching where IBL was implemented has shown.



The teacher was teaching about the properties of triangles based on their angles and the teacher only acted as a facilitator by asking lots of questions. The very reason of incorporating IBL was to provide the learning

opportunities to the students. The students not only answered the questions in the video but also proved it by using different and unique methods. The teacher only organized the activities and asked lots of questions while all the learning happened amongst the students.

## Paper folding activity to realize the IBL strategy in the classroom



After the participants familiarized IBL strategy, participants were provided a paper strips each and asked to fold accordingly. They were then asked to note down their observations mainly to identify the type of IBL. This gave them the chance to experience IBL as students and gauge the effectiveness of the strategy on their own.

### Possible barriers

Inquiry-based learning is an excellent strategy but it does come with its fair share of barriers. These barriers were highlighted in detail along with ways to tackle them. Some of the barriers that were highlighted are:

- Teachers do not know how to incorporate the strategy in the classroom
- The pressure to fulfil the curriculum
- IBL does not suit an exam-based assessment

With the curriculum being rationalized recently and more rationalization to come in the future the bulky syllabus along with the time constraints will no longer be a problem.

### Activity: Lesson design based on types of IBL

With the theory part done, it was time to put theory into practice and this was done using the next two activities. The teachers were given the chance to create at least a lesson based on each type of inquiry-based learning. The teachers came up with relevant topics and created lessons that fully incorporated each of the inquiry-based learning. Some of the topics they came up with were:

- Sliding
- Equivalent fraction
- Adding fractions
- Rotation



### Session 3

The third session of the professional development program for Mathematics was spared for an audience with honourable Dasho Dzungdag accompanied by other sector heads. While in the audience, the Chief Education Officer highlighted the rationale behind initiating such professional development programs for the teachers in Tsirang Dzongkhag, to include few, first, to improve the academic performance of the student. Second, to motivate and generate the interest of students in learning any subject. Third, to meet the requirement of 40 hours professional development program for the teachers. Moreover, the chief of the Dzongkhag education office also presented the academic performance summary sheet; the academic learning score, Dzongkhag student pass percentage, the proportion of students achieving

more than 60 per cent in a STEM subject. Finally, he stated that “this is happening only due to funding support from GoI, under PTA, through the support of TPSD, MOE.”

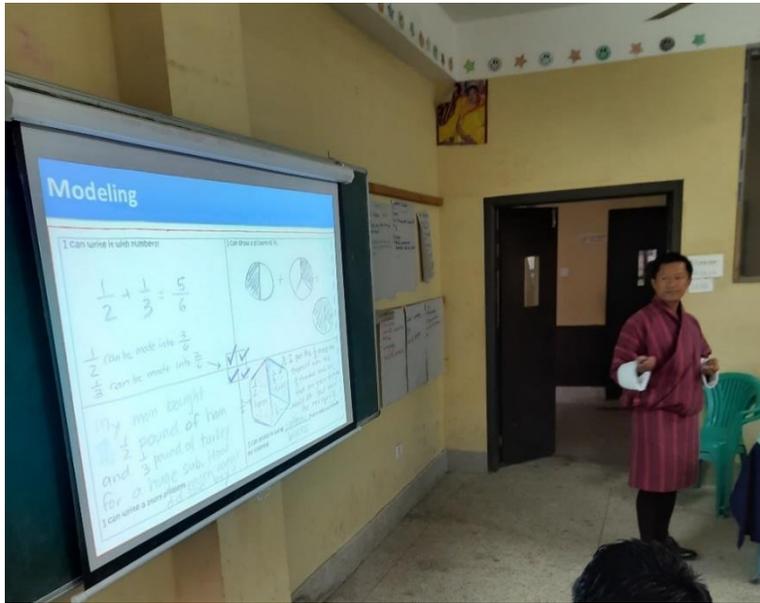
“I am impressed with the programs and initiatives are taken by Chief DEO. I value this kind of professional related program” was the opening statement of honourable Dasho Dzungda. Dasho was very much concerned about the approaches teacher to adopt to teach the students. Inline to this, Dasho stated how he was told to memorize “Druk and Drukpa” reader those days. Back then, students were made to memorize the facts and procedures.

Otherwise, these days “Perhaps the most challenging to be a leader in the 21<sup>st</sup> century is knowing oneself.” Being an exemplary, model and keeping oneself advance in any filed is necessary as a teacher. “students are the mirror of teacher” if students fail in any field no doubt teacher also fails together. Dasho also emphasized, to inculcate the growth mindset and also building competencies of the student will happen only through a teacher’s signature strength, with diligent work, and genuinely dedication towards the profession. Impact fully, a student will learn any subject meaningfully and more importantly, students will also start liking the teacher. Lastly, Dasho reminded that with the curriculum being so bulky teachers need to teach students with representative questions rather than solving every question. Only then, the teacher does not fail in any sense of moral ground.

## Session 4

### Modelling and multiple solutions

The next part highlighted the importance of modelling mathematical concepts in multiple



ways. Teachers should not stick to one solution and let the students use multiple approaches/solutions to solve questions. An example of how to teach the addition of fractions was shown. There were computational ways along with catering to the different learning abilities

through the usage of diagrams and real-life problems.

### Group Activity

With the basis of modelling and multiple solutions covered, an activity was given that required of the teachers to choose a topic and present various methods they knew to present the problem to their students. The teachers came up with different methods based on topics and many of the teachers not only took away new strategies but new ways of solving basic topics like multiplication. Some of the topics presented were:

- Integer
- Multiplication
- Adding fractions
- Multiplication

Some of the methods were relatively unknown and it was a great learning experience for all the teachers.



## Manipulative

Manipulative and TLM are basic tools that are expected to be used by every teacher yet it not used frequently or in the right way. To recapitulate and bring forth the excitement of using TLMs, a topic on using manipulative was presented. Since the teachers are already well versed in the usage of TLMs, an activity was given that required them to make use of different TLMs provided to come up with exciting ideas to teach different concepts.



**Teachers display different ideas on using manipulative.**

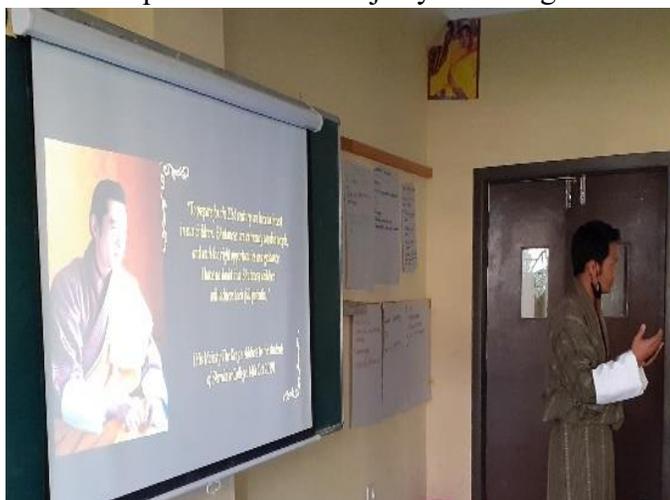


Each group made full use of the manipulative given to them and came up with creative and innovative ideas on how to use each. Each group displayed their work and shared their ideas with other participants on how they would make use of the manipulative. All the teachers showed enthusiasm while using manipulative and the consensus was that they had the most fun while playing with the manipulative.

**PROFESSIONAL DEVELOPMENT PROGRAM FOR TEACHERS**  
**STRATEGIES FOR TEACHING MATHEMATICS**  
**25-27TH OCTOBER, 2020**  
**VENUE: TSIRANGTOE CENTRAL SCHOOL**  
**ATTENDANCE REPORT**

Sl	Name	school	Employee ID	Subject
1	Tenzin Wangdi	Tsirangtoe CS	200501349	Math
2	Dorji Drakpa	Tsirangtoe CS	200701245	Math
3	Sharman Powdel	Tsirangtoe CS	201001433	Math
4	Dugda Dorji	Tsirangtoe CS	201202135	Math
5	Tshering Dorji	Tsirangtoe CS	200801579	Math
6	Hem Kumar Gotamey	Sergithang PS	201101614	Math
7	Sherab Wangdi	Sergithang PS	20190414818	Math
8	Sonam Yuden	Sergithang PS	20200116492	Math
9	Tsheltrim Dorji	Phuentenchu PS	20130201403	Math
10	Dorji Wangmo	Phuentenchu PS	20130201614	Math
11	Cheten Wangchuk	Semjong PS	200301136	Math
12	Kinley Tshering	Semjong PS	2009014915	Math
13	Pelden Dorji	Gosaling PS	200201207	Math
14	D.B.Chhetri	Gosaling PS	8907029	Math
15	Damchoe Yezer(RP)	Tsirangtoe CS	20200116319	RP
16	Sangay Kinzang (RP)	Damphu MSS	20110390	RP
17	Yeshi (RP)	Damphu MSS	201101454	RP
18	Kelzang Chodup	Education Sector	200307262	
19	Tshering	Education Sector	9707107	

**Day 2, Session 1.** The session started with a quote from His Majesty The King's address to the students of Sherubtse college on the 14<sup>th</sup> October 2019. His Majesty's address, "To prepare for the 21<sup>st</sup> century, we have to invest in our children. Bhutanese are extremely capable people, and with the right opportunities and guidance, I have no doubt that Bhutanese children will achieve their full potential." After having shared the King's concern and trust, the presenter led them through with first activity regarding sharing the best practices in the school in



teaching mathematics. Participants shared, to include few, “I teach concept first and then go for activities.” Similarly, “I am teaching math for the first time and as shared by my friends, I explain the concept and go for the activity.” The next part included the presenter letting the participant identify and differentiate between exercise and problem-related question from the mathematics textbook of any level. This was followed by a clarification from the presenter on the difference between exercise question and problem-related question.



## Session 2

The session started with input from the presenter on the different types of problem that can be found in the mathematics textbooks. The session also included on how to use the strategy IDEA to solve each type of problem. After a brief explanation, the participants were given an activity that required them to identify an example of each type of problem from the



textbook. After they identified the different types of problems, they were given an additional activity that required of them to implement IDEA and solve the problems. The presenter let each group (5 groups divided based on mathematical content standards) to present their activity. This activity was mainly conducted so that the teachers could identify the different types of problems from the textbook and apply the problem-solving process IDEA appropriately.

### Session 3

30 minutes of the 3<sup>rd</sup> session was allotted for human resource policy briefing. The briefing was essential regarding the ZEST system, teacher transfer policy and procedures for availing any kind of leave. Apart from that, the Chief Education officer shared concerns



about taking care of the unique culture of being a Bhutanese; it is essential to wear our national dress of Gho and Kira during national festivals. According to Chief, “teachers are the agents of change,” and students have more faith in their teachers than other people so teachers have to realize this and be responsible with the power they hold.



The session continued with another strategy: problem-based learning. Since the strategy was similar to the earlier concept, the topic was only explored briefly and most of the work was done by the participants. An activity was given where the teachers chose a topic from the

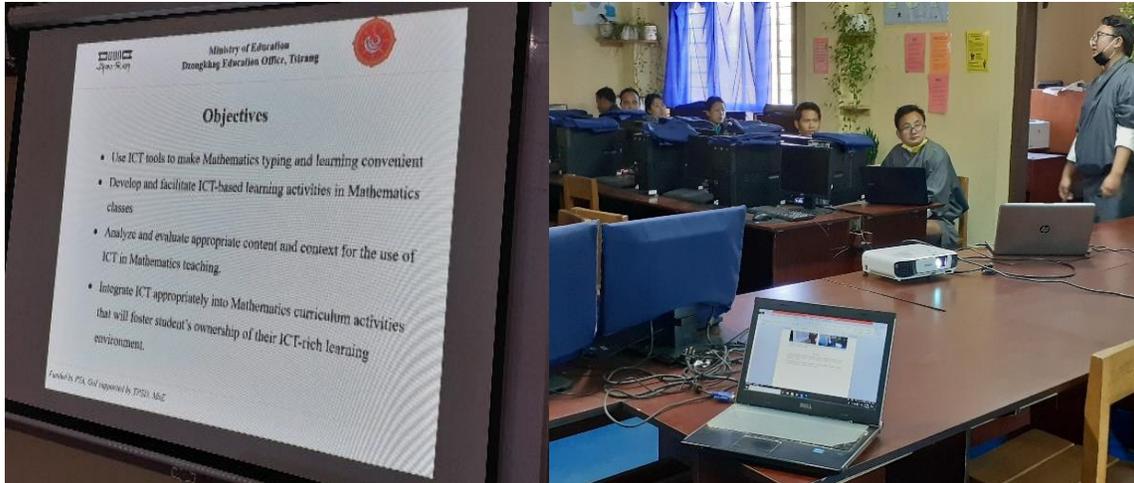
textbook and created a lesson based on problem-based learning.

### Session 4

The last session of the day was conducted in the ICT lab. The facilitator introduced the strategy along with the benefits of incorporating ICT in a mathematics classroom. The three tools that were introduced were:

- MathType

- Geogebra
- Mentimeter and ST Maths



MathType was introduced to the participants and they were given time to explore the new software. One of the major difficulties’ teachers face in typing mathematical equations and symbols during the creation of lesson plans and examination papers, so to make the task easier for them this software was introduced. After the teachers had explored, they were oriented in detail on how to use MathType and incorporate it into Microsoft Word.

### Day 3, Session 1. Integrating ICT in teaching of mathematics

The session started with the facilitators helping the teachers install **MathType** in their laptops. Building on what was learned in the previous session, more features were explored and an activity that required of them to create a different type of mathematical

Mathematical Equations

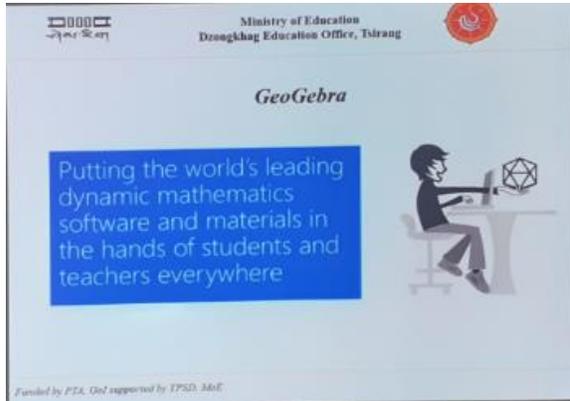
$y = x^2 \pm \mu \tan x$	$y = \sqrt{\frac{3}{16}} \sin x$	$\lim_{\delta x \rightarrow 0} 45$
$\frac{dx}{dy} = \sin x$	$\sum_{i=1}^5 X_i Y_i$	$\begin{pmatrix} 3 & 7 & 19 & 4 \\ 5 & x & 5 & 6 \\ 9 & 8 & 7 & 8 \end{pmatrix}$
$\sphericalangle 90^\circ$	$\therefore \triangle ABC \simeq \triangle XYZ$	$\Rightarrow y \leq 2x + 5$
$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (X_i - \bar{X})^2$ $s_{N-1} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (X_i - \bar{X})^2}$		

equations, formulae and symbols were given. They were also tasked with creating different

types of matrices along a number line. The teachers seemed to enjoy using the software and most expressed excitement in using the software in the future.

## Session 2 and 3

The next 2 sessions were allotted to be focused on the use of GeoGebra. It is free software

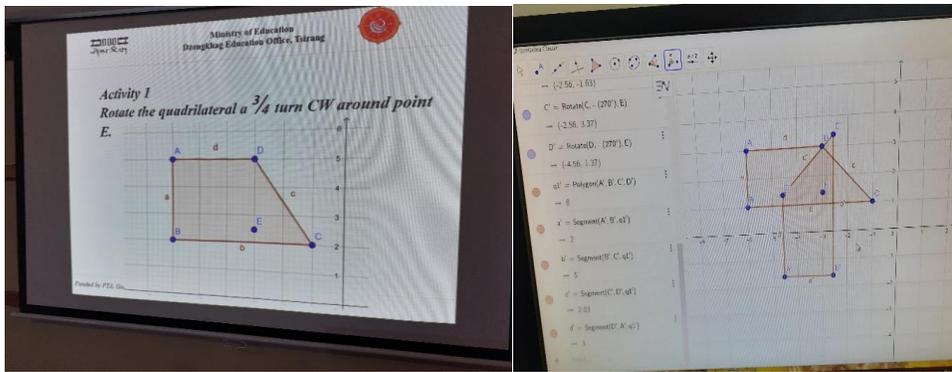


that is available both online and offline. The main purpose of introducing GeoGebra was to give the teachers access to thousands of premade resources online along with the ability to create graphs easily to use in their lesson plan or examination papers.

The participants were thoroughly oriented on the use of GeoGebra in the next two

sessions. The topics that were covered are:

- Creation of graphs based on equations
- Creation of line and line segments
- Finding the intersection point of lines
- Creation of polygons
- Creation of different types of circles
- Creating a number line
- Creation of polygons
- Transformation
- Data analysis

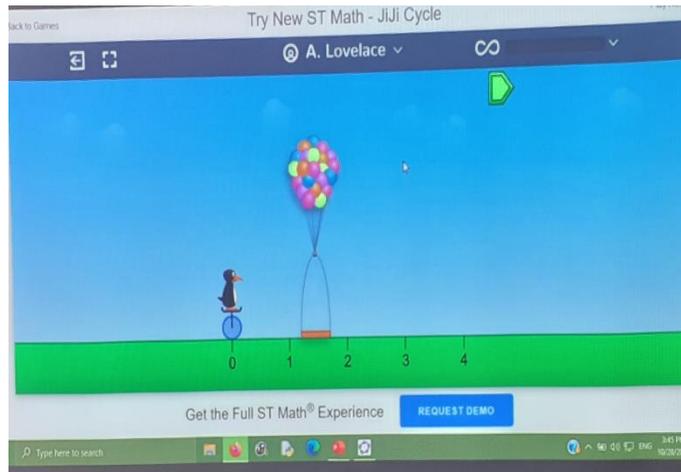


*Participants activity*

Each topic was covered in a detailed manner and many activities were conducted that required of the participants to use what they had learned to create different types of lines and shapes. It was one of the most interactive sessions of the whole PD program.

## Session 4

The last session focused on 2 topics: Mentimeter and ST Maths. ST Maths is an interactive website that provides visual games for visual learners and is created based on solid research. 3 games that focused on fractions, volume and variables were shown as an example, then the teachers were given time to explore the different games found on the website. Next part covered the online quiz/presentation website, Mentimeter. The teachers were oriented in a detailed manner on how to use Mentimeter to create an interactive presentation and quiz. They were also oriented on sharing this to the students via social media, link or the use of a code. The teachers were allowed to participate in a quiz created by the facilitators so that they could get hands-on practice. This was followed by an activity in which the teachers created a quiz of their choice and played among themselves in groups.





## Venue: Mendrelgang Central School

### Day 1, Session 1.

All the participants started the day and the mathematics professional development program with 2 minutes of mindful meditation. This helped in calming the minds of the participants and helping them relax for the day ahead.



The strategy that was to be learned for the day was introduced through the use of an open-



ended diagram. It made the teachers curious and gave them a hint on the upcoming strategies would talk about. Different teachers had different opinions on what the picture could mean but the consensus was that it was a diagram depicting the constructivist point of learning.

### **Background:**

The teachers were then oriented on the educational background of 2019 in Tsirang Dzongkhag. This was done so that they could see how the students had performed compared to the goals set by the dzongkhag in the previous year. This was also done to show the teachers why this PD was being conducted and its importance.

The background included academic achievement summary including academic score, proportion achievement and pass percentage. Upon seeing the low academic score and the low number of proportion students, the teachers were very much worried and were eager to participate.



**Activity:** What are the possible reasons for students scoring low marks in mathematics?

The next part involved a brainstorming activity in which the teachers tried to figure out why the students were not doing well in Mathematics.

The reasons the teachers came up with are:

- Stigma
- Lack of parental support
- Lack of practice
- Bulky syllabus
- Teacher competence



### **Intentions vs Implementation**

The curriculum intentions in general are found in the first pages of every mathematics textbook in our schools, yet it was no surprise that many were not aware of it. To make them familiar and curious about what the curriculum intentions are, a key point was shown and each intention was explained briefly. The intentions are detailed and expect a lot from the teachers, yet there is a big gap between implementation and intentions. Most of what is expected is thwarted by the bulky syllabus, systematic old-style teaching, the large number of students in a class, stigma against mathematics and the time constraint.



## Strategies

3 strategies were included for the day. The strategies are:

- Inquiry-based learning
- Modelling and multiple solutions
- Use of manipulative



### Inquiry-based learning (IBL)

The first strategy was inquiry-based learning. A detailed explanation of what IBL is was given that included its definition, the advantages of using it, the roles teachers play in implementing IBL, the types of IBL, the steps that should be followed in implementing IBL and finally the four pillars of IBL in mathematics. The session covered the basic



was something very relevant and usable in a mathematics classroom.

understanding of IBL and not the specific implementation in a mathematics classroom. The teachers displayed immense interest in the strategy as it

## Session 2

To show the teachers a basic understanding of what inquiry-based learning expects from the teachers, a video of real classroom teaching was shown. The teacher was teaching about different types of triangles based on their angles and got the questions from the students and then let other students answer it. They not only answered it but proved it by using different and unique methods. The teacher acted as a facilitator by organizing the activities and asking lots of questions to gauge the thought process of the students.



After the teachers had got a basic understanding of what inquiry-based teaching required from them, it was time to let them experience what it meant. To do that they were all given



paper strips and asked to fold accordingly. They were then asked to note down their observations based on a structured guide of questions by the resource teacher.

### **Possible barriers**

Inquiry-based learning is an excellent strategy but it does come with its fair share of barriers. These were also highlighted along with ways to tackle them. Some of the barriers that were highlighted are:

- Teachers do not know how to incorporate the strategy in the classroom
- The pressure to fulfil the curriculum
- IBL does not suit an exam-based assessment



### Session by CDEO

The chief DEO attended the PD program with the participants and took a short session providing the background of the program. He highlighted the need for the PD followed by acknowledging those that made the program possible. The chief gave the teachers detailed information on the mathematics results of 2019 by each school. This included the ALS, proportion and pass percentage. One of the main talking points was the quality of education. The chief highlighted that having a 100% pass percentage did not equal to good quality of education.



### Session 3

#### Activity: Lesson design based on structured IBL

With the theory part done, it was time to put theory into practice and this was done using the next two activities. The teachers were given the chance to create 3 lessons based on each type of inquiry-based learning. The teachers came up with relevant topics and created lessons that fully incorporated each of the inquiry-based learning.





The next part highlighted the importance of modelling mathematical concepts in multiple ways. An example of how to teach the addition of fractions was shown. There were computational ways along with catering to the different learning abilities through the usage of diagrams and real-life problems.

### **Group Activity**

With the basis of modelling covered, an activity was given that required of the teachers to choose a topic and present various methods they knew to present the problem to their students. The teachers came up with different methods based on topics and many of the teachers not only took away new strategies but new ways of solving basic topics like multiplication. Some of the topics presented were:

- Adding Integers
- Solving system of linear equations

○ Multiplication



**Session 4. Presentation on the multiple solution.**



Manipulative and TLM are basic tools that are expected to be used by every teacher yet it not used frequently or in the right way. To recapitulate and bring forth the excitement of using TLMs, a topic on using manipulative was presented. Since the teachers are already well versed in the usage of TLMs, an activity was given that required them to make use of different TLMs distributed by the facilitators to teach different mathematical topics.

**Display and gallery walk**

Each group made full use of the manipulative given to them and came up with creative and innovative ideas on how to use each. Each group displayed their work and shared their ideas with other participants on how they would make use of the manipulative. All the

teachers showed enthusiasm while using manipulative and the consensus was that they had the most fun while playing with the manipulative.



## Day 2, Session 1.

The session graced with His Majesty The King's address to the students of Sherubtse College, 14<sup>th</sup> Oct 2019. His Majesty remarked, "To prepare for the 21<sup>st</sup> century, we have to in our children. Bhutanese are extremely capable people, and with the right opportunities and guidance, I have no doubt that Bhutanese children will achieve their full potential."



After having shared the King's concern and trust, the presenter led them through with first activity regarding sharing the best practices in the school in teaching mathematics. Participants shared, to include few, "I teach concept first and then go for activities." Similarly, "I am teaching math for the first time and as shared by my friends, I explain the concept and go for the activity." Followed by presenter letting the participant identify and differentiate between exercise and problem-related question from the textbook of any level. Presenter clarified the difference between exercise question and problem-related question.

## Session 2

The session resumed exactly at 11:00 am after a tea break. The facilitator led the session with activity on identifying the problem from the textbook. Presenter lets each group (5 groups divided on process standard) present their activity. This activity was mainly to help the child know how to solve any kind of problem through the **problem-solving process**; identify the problem, develop the plan, evaluate and assess.

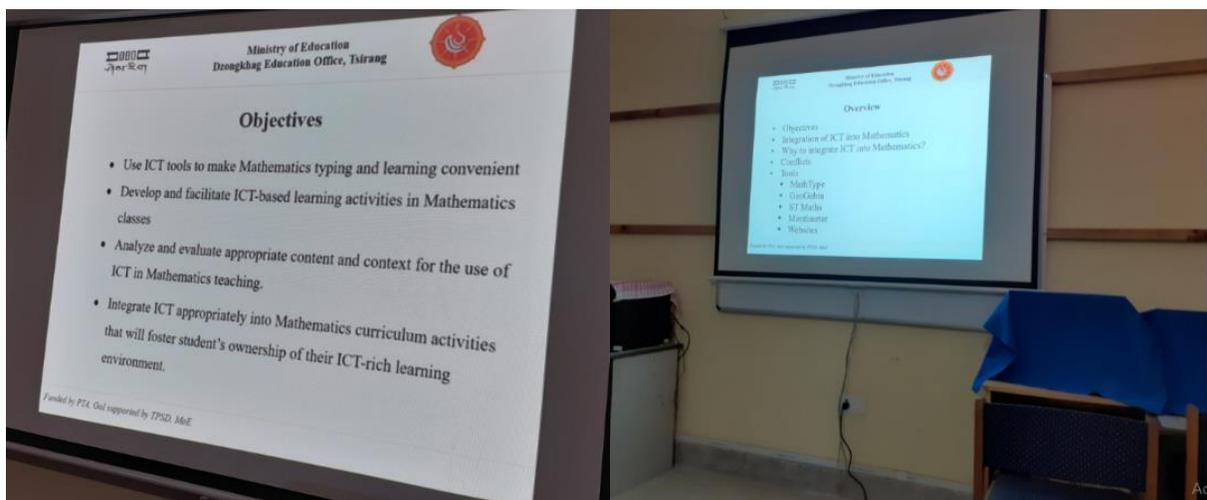


Once the problem has been solved using the problem-solving process the facilitator led with new strategy “**problem based learning**”



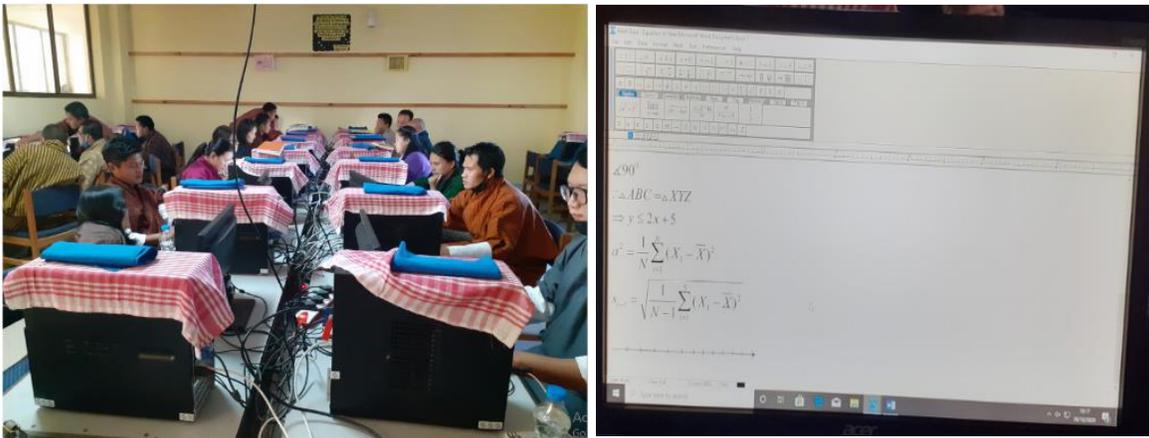
### Session 3

The third session resumed with a presentation on integrating ICT in mathematic class. The presenter presented the rationale behind this session. Along with this, the presenter also shared the importance of ICT literacy in the 21<sup>st</sup> century. Moreover, participants were introduced to the features of MathType software. This software will immensely help mathematics teachers while in need of equations particularly in setting up test papers.



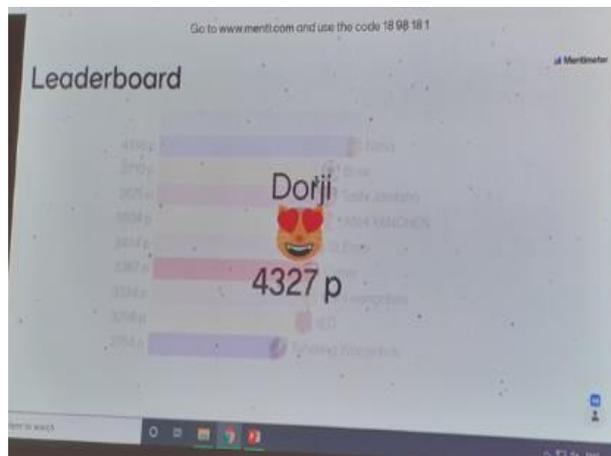
## Session 4

In this session participants explored on the MathType software based on the activity designed. The activity was aimed to explore various features, to include few, such as typing equation, matrices, derivatives, fraction, number line, superscript and subscript. Participants practice vigorously and they are much more confident in using MathType features



## Day 3, Session 1.

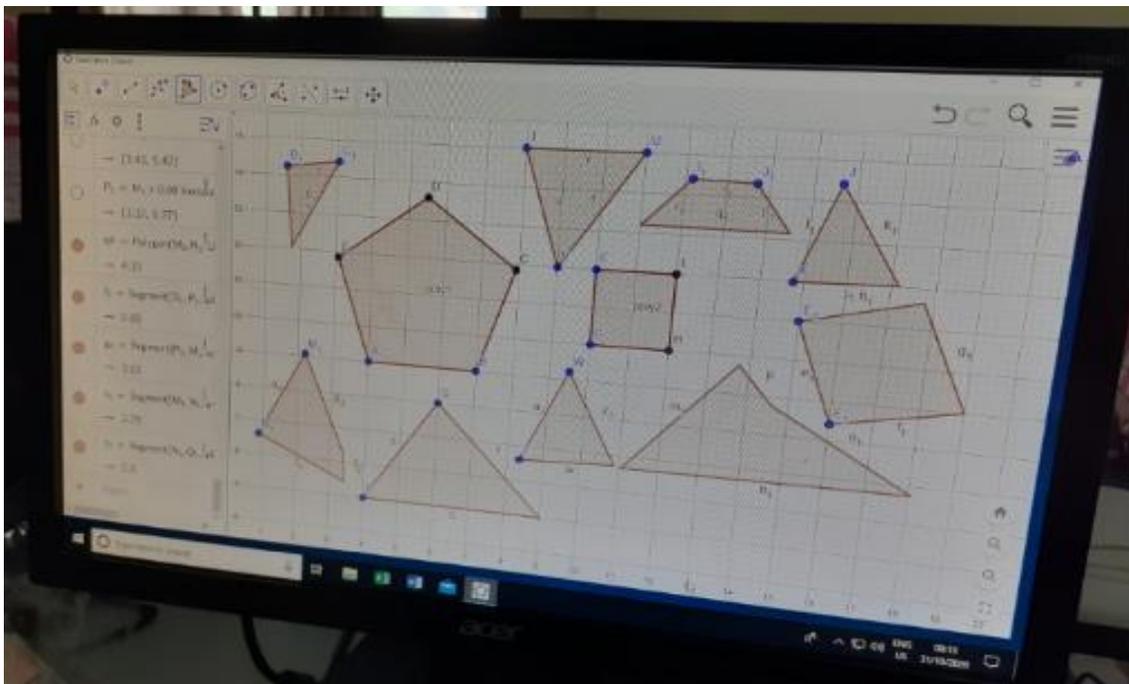
The first session focused on 2 topics: Mentimeter and ST Maths. ST Maths is an interactive website that provides visual games for visual learners and is created based on solid research. 3 games that focused on fractions, volume and variables were shown as an example, then the teachers were given time to explore the different games found on the website. Next part covered the online quiz/presentation website, Mentimeter. The teachers were oriented in a detailed manner on how to use Mentimeter to create an interactive presentation and quiz. They were also oriented on sharing this to the students via social media, link or the use of a code. The teachers were allowed to participate in a quiz created by the



facilitators so that they could get hands-on practice. This was followed by an activity in which the teachers created a quiz of their choice and played among themselves.

### Session 2 and 3

**The session** resumed with an introduction to the software, GeoGebra. GeoGebra is an interactive geometry, algebra, statistics and calculus application, intended for learning and



teaching mathematics and science from primary school to university level. It also provides services to leading global brands and rising-star startups in STEM education.

The participants were thoroughly oriented on the use of GeoGebra in the next 2 sessions.

The topics that were covered are:

- Creation of graphs based on equations
- Creation of polygons
- Creating a number line
- Creation of polygons
- Transformation
- Data analysis

**PROFESSIONAL DEVELOPMENT PROGRAM FOR TEACHERS  
STRATEGIES FOR TEACHING MATHEMATICS  
29-31ST OCTOBER, 2020  
VENUE: MENDRELGANG CENTRAL SCHOOL  
ATTENDANCE REPORT**

<b>Sl</b>		<b>School</b>	<b>Employee ID</b>
1	Tshering Wangchuk	Mendrelgang PS	201001630
2	Tenzin Wangda	Mendrelgang PS	201001682
3	C.P Ghimirey	Mendrelgang PS	8807042
4	Tashi Jamtsho	Mendrelgang CS	201202228
5	Dorji Chodup	Mendrelgang CS	200701372
6	Tshering Choden	Mendrelgang CS	20140303631
7	Tashi Yangchen	Mendrelgang CS	20140303634
8	Kinley Penjor	Mendrelgang CS	20200116453
9	Tenzin Wangmo	Mendrelgang CS	20200116452
10	Sonam Tshering	Mendrelgang CS	20200317305
11	Karma Choki	Mendrelgang CS	201001472
12	Nima Lhamu	Barshong PS	20170308851
13	Yechang Lhamo	Barshong PS	20200317503
14	Tashi Wangchen	Barshong PS	2008225
15	Chimi	Patsaling PS	201101624
16	Sangay Wangdi	Patsaling PS	20170308650
17	Sonam Wangdi	Rangthangling PS	200301219
18	Damchoe Yoezer (RP)	Tsirangtoe CS	20200116319
19	Sangay Kinzang (RP)	Damphu MSS	201101390
20	Yeshi (RP)	Damphu MSS	201101454
21	Kelzang Chodup	Education Sector	200307262
22	Tshering (Dy.CDEO)	Education Sector	9707107



### Venue: Damphu Central School

#### Day 1, Session 1. Background of conducting professional development by CDEO.

The chief DEO attended the PD program with the participants and took a short session providing the background of the program. He highlighted the need for the PD followed by acknowledging those that made the program possible. The chief gave the teachers detailed information on the mathematics results of 2019 by each school. This included the ALS, proportion and pass percentage. One of the main talking points was the quality of education. The chief highlighted that having a 100% pass percentage did not equal to good quality of education.



The first session of the three days mathematics professional development program started with a two to three minutes of mindful meditation. This was done to calm the minds of the participants and grab their attention.

Introduction plays a vital role in capturing the student's attention and making them curious about what they are going to learn.

The strategy was introduced through the interpretation of an open-ended diagram. Different teachers had different opinions on what the picture could entail with the universal interpretation being the diagram represented the constructivist view of learning.



### **Background:**

Before we could start with the professional development program, it was important for the participating teachers to know the state of mathematics education in the Tsirang dzongkhag.

They needed to know why the professional development program was being conducted, so to give them a goal, to give them what the PD looks to accomplish, a brief background of dzongkhag achievement summary

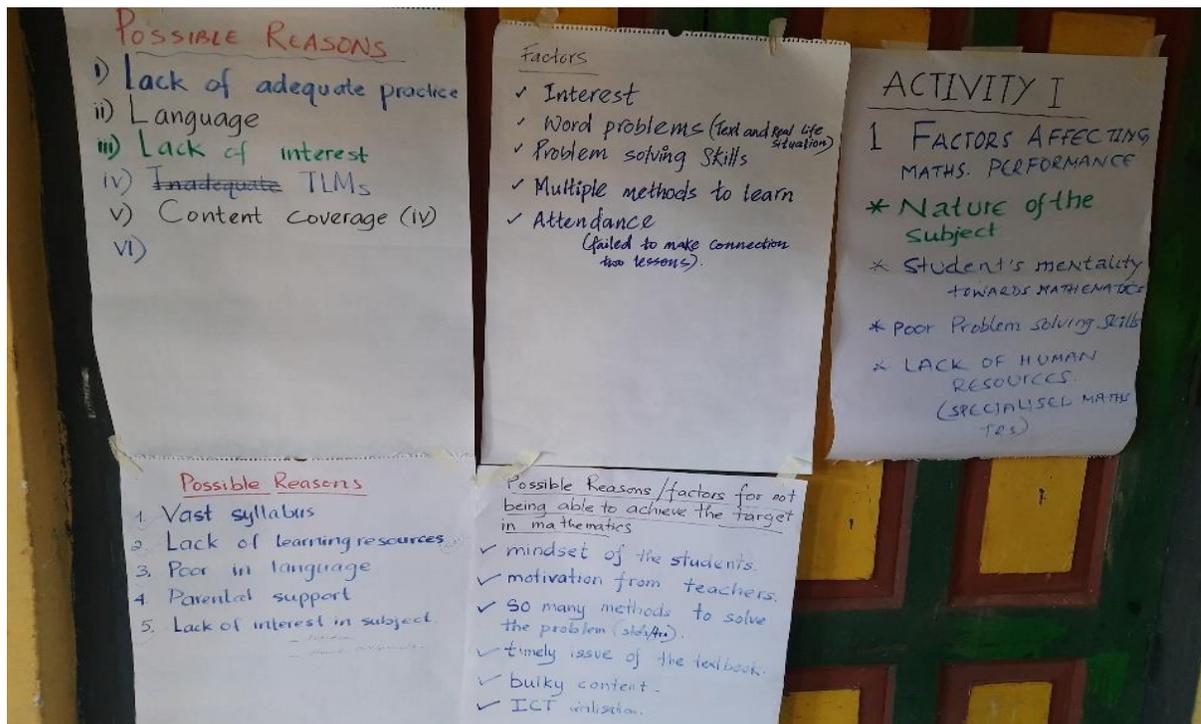
including academic score, proportion achievement and the pass percentage was presented to the teachers. Upon seeing the low academic score



and the low number of proportion students, the teachers were very much worried and were eager to participate.

Activity: What are the possible reasons students score low marks in mathematics?

A brief background of the educational state in Tsirang was presented, and the big question now was why were the students not scoring good marks in Mathematics? Rather than give them generic reasons the question was thrown to the teachers, and using their years of experience in teaching mathematics, they came up with good reasons:



The teachers came up with very good reasons, and the next part was just presenting what they had discussed concisely. This was made possible by focusing on what the curriculum expects from the teachers. This intention is found in the first pages of every mathematics textbook in our schools, yet it was no surprise that many had not gone through the intentions of the curriculum. To make them familiar and curious about what the curriculum intentions are, a diagram was shown and each intention was explained briefly. The intentions are detailed and expect a lot from the teachers, yet there is a big gap between implementation and intentions. Most of what is expected is thwarted by the bulky syllabus, systematic old-style teaching, the large number of students in a class, stigma against mathematics and the time constraint.



## Strategies

The why portion of the program was over, so now came the how part. How to solve these problems so that the students can learn mathematics better and perform better in their examinations. What strategies we could use to solve these problems? The answer was what the professional development program is all about and the first of many strategies were covered on the first day.

The strategies included:

- Inquiry-based learning
- Modelling and multiple approaches
- Use of manipulatives



### **Inquiry-based learning (IBL)**

The first strategy was inquiry-based learning. A detailed explanation of what IBL is was given that included its definition, the advantages of using it, the roles teachers play in implementing IBL, the types of IBL, the steps that should be followed in implementing IBL and finally the four pillars of IBL in mathematics. The session covered the basic understanding of IBL and not the specific implementation in a mathematics classroom. The teachers displayed immense interest in the strategy as it was something very relevant and usable in a mathematics classroom.



## Session 2

To show the teachers a basic understanding of what inquiry-based learning expects from the teachers, a video of real classroom teaching was shown. The teacher was teaching about different types of triangles based on their angles and got the questions from the students and then let other students answer it. They not only answered it but proved it by using different and unique methods. The teacher acted as a facilitator by organizing the activities and asking lots of questions to gauge the thought process of the students.



### Possible barriers

Inquiry-based learning is an excellent strategy but it does come with its fair share of barriers. These were also highlighted along with ways to tackle them. Some of the barriers that were highlighted are:

- Teachers do not know how to incorporate the strategy in the classroom
- The pressure to fulfil the curriculum
- IBL does not suit an exam-based assessment



### Activity: Lesson design based on structured IBL

With the theory part done, it was time to put theory into practice and this was done using the next two activities. The teachers were given the chance to create 3 lessons based on each type of inquiry-based learning. The teachers came up with relevant topics and created lessons that fully incorporated each of the inquiry-based learning. Some of the topics they came up with were:

- Sliding
- Equivalent fraction
- Adding fractions
- Rotation



### Session 3

The next part highlighted the importance of modelling mathematical concepts in multiple ways. An example of how to teach the addition of fractions was shown. There were computational ways along with catering to the different learning abilities through the usage of diagrams and real-life problems.



### Group Activity

With the basis of modeling covered, an activity was given that required of the teachers to choose a topic and present various methods they knew to present the problem to their students. The teachers came up with different methods based on topics and many of the teachers not only took away new strategies but new ways of solving basic topics like multiplication. Some of the topics presented were:

- Polygons
- Solving algebraically
- Interest
- Multiplication



## Manipulative

Manipulatives and TLM are basic tools that are expected to be used by every teacher yet it not used frequently or in the right way. To recapitulate and bring forth the excitement of using TLMs, a topic on using manipulatives was presented. Since the teachers are already well versed in the usage of TLMs, an activity was given that required them to make use of different TLMs distributed by the facilitators to teach different mathematical topics.



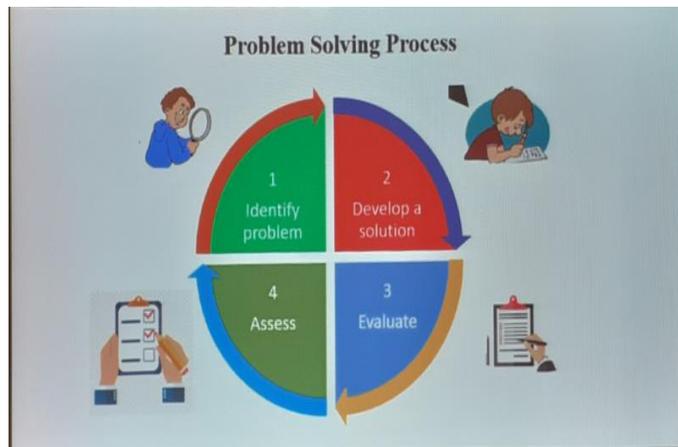
## Display of manipulative



Each group made full use of the manipulative given to them and came up with creative and innovative ideas on how to use each. Each group displayed their work and shared their ideas with other participants on how they would make use of the manipulative. All the teachers showed enthusiasm while using manipulative and the consensus was that they had the most fun while playing with the manipulative.

## Day 2, Session 1. Session on problem solving process

The session graced with His Majesty The King's address to the students of Sherabtshe College, 14<sup>th</sup> Oct 2019. His Majesty remarked "To prepare for the 21<sup>st</sup> century, we have to invest in our children. Bhutanese are extremely capable people, and with the right opportunities and guidance, I have no doubt that Bhutanese children will achieve their full potential." After having shared the King's concern and trust, the presenter led them through with first activity regarding sharing the best practices in the school in teaching mathematics. Participants shared,



to include few, "I teach concept first and then go for activities." Similarly, "I am teaching math for the first time and as shared by my friends, I explain the concept and go for the activity." Followed by presenter letting the participant identify and differentiate between exercise and problem-related question from the textbook of any level. Presenter clarified the difference between exercise question and problem-related question.

## Session 2

The session resumed exactly at 11:00 am after a tea break. The facilitator led the session with activity on identifying the problem from the textbook. Presenter lets each group (5 groups divided on process standard) present their activity. This activity was mainly to help



the child know how to solve any kind of problem through the **problem-solving process**; identify the problem, develop the plan, evaluate and assess.

Once the problem has been solved using the problem-solving process the facilitator led with new strategy “**problem-based learning**”

### Session 3

The third session resumed with a presentation on integrating ICT in mathematic class. The presenter presented the rationale behind this session. Along with this, the presenter also shared the importance of ICT literacy in the 21<sup>st</sup> century. Moreover, participants were introduced to the features of MathType software. This software will immensely help mathematics teachers while in need of equations particularly in setting up test papers.



## Session 4

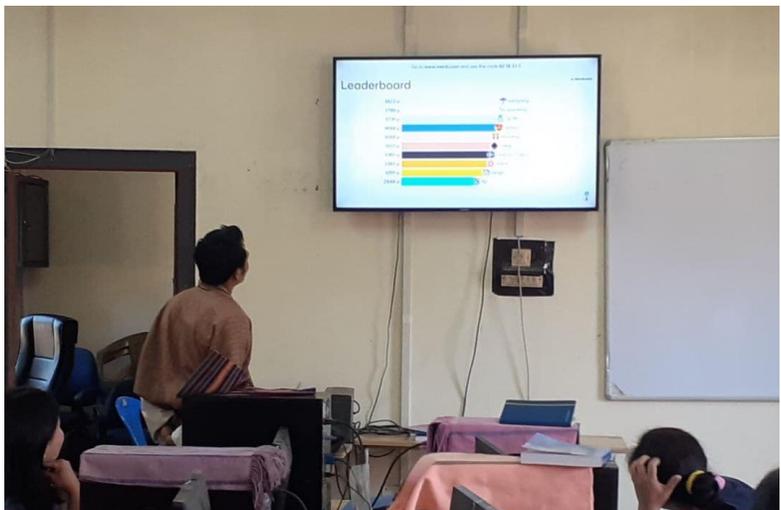
The last session of the day was conducted in the ICT lab. The facilitator introduced the strategy along with the benefits of incorporating ICT in a mathematics classroom. The 3 tools that were introduced were:

- MathType
- Geogebra
- Mentimeter and ST Maths

MathType was introduced to the participants and they were given time to explore the new software. One of the major difficulties' teachers face in typing mathematical equations and symbols during the creation of lesson plans and examination papers, so to make the task easier for them this software was introduced. After the teachers had explored a little bit, they were oriented in detail on how to use MathType and incorporate it into Microsoft Word.

### Day 3, Session 1. Integration of ICT in mathematics

The first session started with introducing software, Mentimeter. This will help teachers in general to prepare multiple questions, quiz, and survey. It is an interactive presentation platform that is powerful yet easy-to-use with features that enables us to prepare, present and analyze presentations. Mentimeter gives every student a voice and stops only the loudest in the class from being heard.

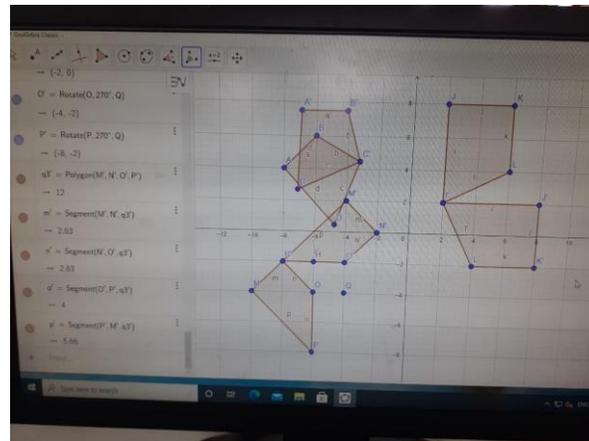
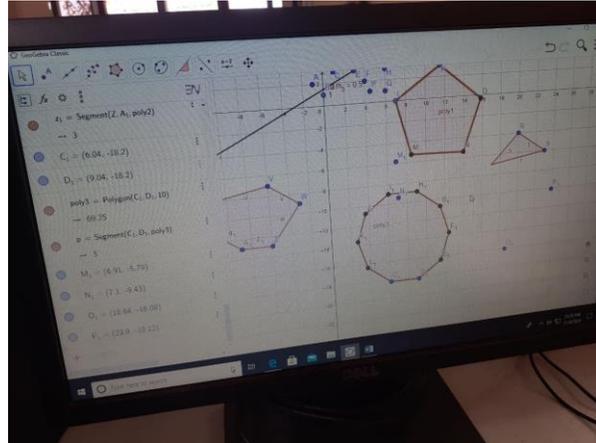


### *Session 2 and 3*

The session resumed with an introduction to the software, GeoGebra. GeoGebra is an interactive geometry, algebra, statistics and calculus application, intended for learning and teaching mathematics and science from primary school to university level. It also provides services to leading global brands and rising-star startups in STEM education.

The participants were thoroughly oriented on the use of GeoGebra in the next 2 sessions. The topics that were covered are:

- Creation of graphs based on equations
- Creation of line and line segments
- Finding the intersection point of lines
- Creation of polygons
- Creation of different types of circles
- Creating a number line
- Creation of polygons
- Transformation
- Data analysis



**PROFESSIONAL DEVELOPMENT PROGRAM FOR TEACHERS  
STRATEGIES FOR TEACHING MATHEMATICS  
2ND -4TH NOVEMBER, 2020  
VENUE:DAMPHU CENTRAL SCHOOL  
ATTENDANCE REPORT**

Sl	Name	School	Employee ID	Subject
1	Kunzang Pelden	Damphu MSS	200601203	Maths
2	Nima Wangdi	Damphu MSS	200801285	Maths
3	Tshering Lhamo	Damphu MSS	200801283	Maths
4	Purnima Rana	Damphu CS	201002004	Maths
5	Tashi Tshering	Damphu CS	20140303900	Maths
6	Ugyen Lhendup	Damphu CS	20140104121	Maths
7	Jamyang Wangmo	Damphu CS	201201615	Maths
8	Sasila Limboo	Damphu CS	20130201558	Maths
9	Samir Kumar Ghosh	Damphu CS	9803006	Maths
10	Dawa Tshering Sherpa	Damphu CS	2107221	Maths
11	Gopal Thapa	Kilkhorthang PS	9006047	Maths
12	Janga Bir Gurung	Kilkhorthang PS	2008295	Maths
13	Sonam Tshering	Doonglagang PS	20170409232	Maths
14	Rudraman Diyali	Doonglagang PS	200502010	Maths
15	Dawa Penjor(Principal)	Doonglagang PS	2008290	Maths
16	Passang Dukpa	Nimazor ECR	9908122	Maths
17	Harka Bdr. Mongar	Tsholingkhar PS	8807033	Maths
18	Kezang Wangmo	Tsholingkhar PS	200401256	Maths
19	Purna Bdr. Rai	Tsholingkhar PS	8906143	Maths
20	Prakash Gurung	Pemathang PS	200801417	Maths
21	Kuenzang Wangdi	Pemathang PS	200605048	Maths
22	Kencho Dorji	Barshong PS	200801495	Maths
23	Damchoe Yoezer (RP)	Tsirangtoe CS	20200116319	Maths
24	Sangay Kinzang (RP)	Damphu MSS	201101390	Maths
25	Yeshi (RP)	Damphu MSS	201101454	Maths
26	Kelzang Chodup (Manager)	Education Sector	200307262	Maths
27	Tshering (DCDEO-Manager)	Education Sector	9707107	Maths

Compiled by: Mr. Damchoe Yezer (TCS)

Mr. Sangay Kinzang (DMSS)

Mr. Yeshi (DMSS)