香港教育大學
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Capstone Project Written Report:

Enhancing SpLD Students' Fraction Learning By Using Experience-Language-Picture-Symbol (ELPS) Framework

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Introduction

Inclusive education, formerly called integrated education, has been implemented by the Hong Kong government since 1997, it aimed to provide support for special educational needs (SEN) students in mainstream schools (Education Bureau, 2014). According to the Legislative Council Secretariat (2019), approximately 40% of SEN students are SpLD in primary school, which is the highest one of SEN. Although the government has resourced schools with extra support in these few years, it is still insufficient for SEN children, especially after they enroll in primary school (Society for Community Organization, 2019). Facing the large number of SEN children, teachers lack enough time and resources to cater to their needs. It leads to poor performance in mathematics among SpLD students, it is more obvious when they are doing arithmetic and reading word questions. Thus, the purpose of this project is to act as an after-class support for SpLD students of improving their performance in learning fractions through ELPS framework. A game-based learning environment with hand-on experiences provided for them to learn, with the verbal, pictorial and symbol expressions, it aimed to enhance their understanding of fractions.

Literature Review

1. The Definition of SpLD and Current Situation in Hong Kong

According to the DSM-5 (American Psychiatric Association, 2013), Specific learning disorder (SpLD) is a neurodevelopmental disorder diagnosed by persistent problems in one of the three areas, including reading, writing and mathematics. There are specific terms that refer to people who have difficulties in these three areas, named Dyslexia, Dysgraphia and Dyscalculia respectively. Dyslexia was the most common type which accounts for approximately 80% among SpLD people (Mather & Wendling, 2012).

In Hong Kong, SpLD was commonly referred to as Dyslexia as it was the only type of SpLD which had a standardized assessment procedure recognized by the Education Bureau (Kwan, 2020). According to the data of the Department of Health (2017), the prevalence of children with SpLD was 9.7 to 12.6%; it was also the most common type of SEN which accounted for around 40% of SEN primary students (Legislative Council Secretariat, 2019).

2. The Detrimental Effect of SpLD on Mathematics

There were well established findings indicating that individuals with SpLD, such as Dyslexia, were more likely to experience mathematical difficulties, even if they were not diagnosed with having Dyscalculia (Jordan et al., 2014).

2.1 Arithmetical difficulties

Refer to the report of EDB (2000), pupils with Dyslexia might encounter various problems in learning mathematics, including difficulties with understanding mathematical symbols and slow calculating speed due to weak working memory capacity. Individuals with Dyslexia were weaker in sense of direction, they might not identify the difference between +, -, × or÷ symbols, or difference between denominator and numerator (Pavey, 2016). Besides, their deficiency in ability of sequencing and alignment also resulted in slower and poorer mathematical performance. Individuals with higher working memory capacity than those with Dyslexia often took shorter time in the arithmetic process (Jordan et al., 2014).

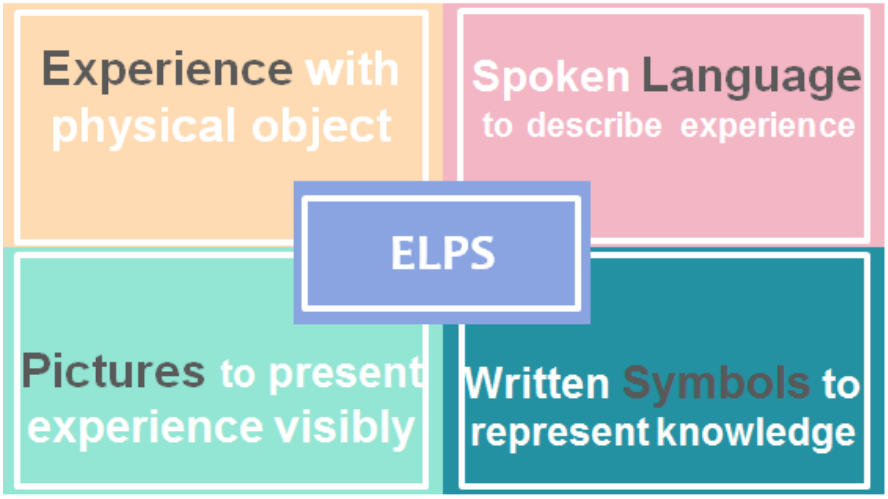
2.2 Reading questions

Reading word questions was one of the struggles of pupils with Dyslexia in doing mathematics correctly (EDB, 2000). To understand mathematics word questions, students are required to have adequate mathematical knowledge, skills and mathematical language while pupils with Dyslexia are more unlikely to process it. Take "subtraction" as an example, questions with "take away", "difference" and "decrease" were often associated with subtraction, however these vocabularies were inconsistent and changeable, and it led to confusion over what mathematical step should be used (Chinn, 2018). Apart from the confusing vocabularies, poor organizational skills also resulted in hardly understanding word questions (Muhamad et al., 2016). Since individuals with Dyslexia were having trouble with reading comprehension, it took longer time and more effort for them to decode the words in

the questions, and sometimes they might misunderstand it.

3. ELPS Approach

ELPS is a learning framework designed by Liebeck (1984); it considered as an active process that students develop their understanding of new concepts in connection with personal experience or prior knowledge and social interaction with others (Wahidah et al., 2020). It consists of four components namely: Experience, Language, Pictures and Symbols. Teachers are encouraged to introduce new concepts associating with students' **experiences**, both academic and in daily life. It also includes hands-on experience with physical objects to consolidate their understanding. The next stage is important to ask students to present their findings they found in the experiences through verbal expression, and teachers are crucial to establish appropriate mathematics **language** for students. The visual representation, **pictures** follows languages to represent mathematical ideas. Mainly there are two types of pictures, one is pictures shown by teachers for demonstration, and another one is pictures created by students, both acts to reinforce their understanding. The last component is requiring students to record their knowledge by mathematical **symbols** after understanding (Lowrie & Patahuddin, 2015).



The ELPS framework has been used in mathematics lessons by some teachers and researchers previously and definite improvements have been shown (Gradini & Bahri, 2018; Nissa, Sanapiah & Yuntawati, 2019). Some studies demonstrated the efficacy of teaching fraction concepts with physical action and objects; it benefited students' learning and problem solving skills (Taylor et al., 2012; Van de Walle et al., 2016). Multiple physical objects were used to help visualize the fraction, including colored regions, fraction strips or bars and paper folding, before they transformed the concept into pictorial representation (Tucker et al., 2006). It was believed that students were more capable of representing fractions in a correct notation way after several ELPS-assisted lessons (Juliangkary & Johar, 2018). Also, it was found that kinesthetic learning style was the most favored preference by dyslexia students; hence their performance might be enhanced by teaching with multiple physical objects (Andreou & Vlachos, 2013). Apart from Liebeck, some scholars also proved the effectiveness of learning through real experience. Piaget supported that interacting with physical objects facilitates children's understanding of new concepts, and a play-based learning environment should be provided for them to explore (Halpenny & Pettersen, 2014). Vygotsky also believed that

children, as an active learner, were learning most effectively when they are interacting with others and the real life environment (Smidt, 2009).

With the teaching design based on the ELPS framework, physical objects and experience were provided for students in every lesson. They were required to express their understanding gained from the experience verbally, for instance, the meaning of fractions, i.e. denominator and numerator. It was believed that their understanding of fraction concepts was deepened after these procedures, confusion was less and they were more familiar with fraction-related questions.

Project Objectives

In this project, 10 sessions of teaching fractions were designed using the ELPS learning framework. Each session involved the four components of ELPS framework and kinesthetic learning style. **Table 1** shows a summary of the designed lesson plan; the details of ELPS components are noted in the detail lesson plan (see Appendix A). This teaching design was aimed at enhancing students' understanding of fraction concepts and better mathematical representation in notation form.

Table 1

Teaching Design Summary

Session	Learning objectives	Activities involving ELPS components
1	• Revision of fair share • To understand fraction is a part of whole (continuous unit)	• Fair share online game • Paper folding

Session	Learning objectives	Activities involving ELPS components
2	• To understand fraction is a part of whole (discrete units) • To find the quantity of $\frac{1}{n}$ in a group of things	• Fraction online game • Dividing stickers
3	• To use $\frac{1}{n}$ to represent the relationship between certain quantity in a group of things • To use $\frac{m}{n}$ to represent the relationship between part and whole	• Matching cards • Drawing on iPAD
4	• To find the quantity of $\frac{m}{n}$ in a group of things • To understand the relationship between 1 and fractions	• Scavenger hunt game • Collage of paper
5	• Revision of $>$ and $<$ • To compare fractions with same denominator	• Alligator game • Coloring grid paper
6	• To compare fractions with same numerator	• Coloring grid paper
7	• To compare three fractions with different denominator and numerator	• Fraction card games
8	• To understand equivalent fractions	• Coloring paper
9	• To calculate addition of fraction with same denominator	• Drawing on iPAD
10	• Revision game	• Fraction board games

Methodology

The project is carried out by adopting an action learning framework throughout the 10 sessions. It is a process that requires participants' planning, acting, reflecting and learning so as to solve problems in the experience (Serrat, 2017). It is usually adopted in a small group of people, named an action learning set that is aimed at working on a problem (Rimanoczy,

2007). When the project is conducted, the activities may be revised in order to fit the participants based on the individual needs of participants, reflection and innovation of set members.

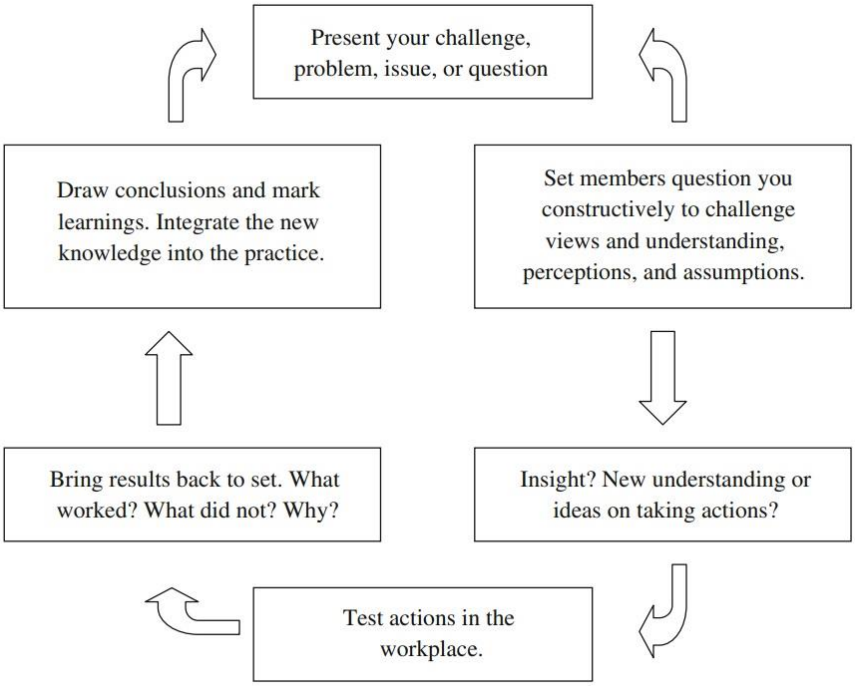


Figure 2

The Action Learning Cycle (Serrat, 2017)

Quantitative Data Collection

Pre-test and Post-test

In this project, pre-test and post-test conducted in the first and the last session to evaluate the effectiveness of using ELPS framework to teach fractions. The pre-test aimed to evaluate students' prior knowledge of fractions and the post-test aimed to measure if their performance improves. The questions of tests were selected and modified from past papers of the Territory-wide System Assessment (TSA) for grade 3 and 6 students. The result of the TSA provided

information about students' knowledge of fractions, their strengths and weaknesses; hence it was chosen to be the questions of tests. The tests include 10 items and there are multiple choice questions and short questions (see Appendix B). Each answer scores 1 mark. The questions chosen cover the content of these 10 sessions and students are required to complete these tests individually. The pre-test and post-test are the same for every student.

Online Motivation Questionnaire (OMQ)

To gain insight in effectiveness of these 10 sessions, the modified version of Boekaerts online motivation questionnaire (OMQ) was used to measure the learning motivation of students (Banas, 2007; Crombach et al., 2003). The OMQ has been used in several studies previously to study motivation of elementary school students (de Koning-Veenstra et al., 2014). Students filled in the questionnaire in the end of the first and the last session. The modified questionnaire contains two parts with a total of 20 items; the 11-15 items are affect-related while the 16-20 items are competence-related (see Appendix C). It aims to analyze the students' motivation via subscales about task attractiveness, task relevance and learning intention. Questions can be answered with mostly five response scales per item, from strongly disagree to strongly agree. Cronbach's alpha has been conducted on two parts of the modified questionnaire separately, and the reliability of part 1 was found to be .870 (Banas, 2007). For the analysis of part 2, the affect-related items and competence-related items were determined to be .857 and .809 respectively.

Formative Assessment

To evaluate students' understanding, a small test had been carried out in the end of each session, except the last session. It aims to evaluate the effectiveness of particular sessions and students' strengths and weaknesses so as to adjust the lesson plan of the following sessions. The format of these assessments is a worksheet or a short questionnaire related to the content of the day. There are no more than 5 items of each formative assessment (see Appendix D).

Besides, evaluation form was provided for peers, school teacher and supervisor after their lesson observation, so as to improve the lesson planning (see Appendix E). The criteria include content, presentation and activities part.

Results and Discussion

Participants

In this project, 7 students from a primary school participated. They had different background of SEN and traits, the characteristics have been summarized in **Table 2**.

Table 2

Participants' Information

Students number	Age	Gender	Inclusion criteria	Remarks
S1	9	F	• SpLD	• Intelligence level: average • Confident in small class • Weak word recognizing skill • Pay attention to playing instead of learning in activities time

Students number	Age	Gender	Inclusion criteria	Remarks
S2	10	F	• SpLD • Speech disorder	• Intelligence level: average • Willing to participate in activities • Easily giving up in word question • Weak word recognizing skill
S3	10	F	• Mathematics result belongs to bottom 10%	• Confident, high learning motivation • Bright • Good at asking questions based on learning content • Eager to start activities
S4	9	M	• Mathematics result belongs to bottom 10%	• Willing to participate in activities • Unconfident to share opinions • Weak understanding in fractions
S5	10	F	• Mathematics result belongs to bottom 10%	• Low learning motivation • Always score the highest • Willing to explain ideas
S6	9	M	• Speech disorder • Limited intelligence • Mathematics result belongs to bottom 10%	• Weak performance in all mathematics, e.g. able to do two-digit addition in this year • Willing to participate in activities • Weak communication skill • Unconfident and shy, seldom talk or ask question
S7	9	F	• SpLD • Speech disorder • ADHD	• Intelligence level: lower average • Willing to participate in activities and performing • Confident in small class • Slow responding

Based on ELPS approach, multiple small group activities were carried out during the lesson, hence 7 students were divided into 2 groups during activities time. The grouping list is stated in **Table 3**.

Table 3

Grouping List

Grouping list	Student name	Remarks
Group 1	S1	
	S5	
	S6	
Group 2	S4	Sub-group 1 (if applicable)
	S7	Sub-group 1 (if applicable)
	S2	Sub-group 2 (if applicable)
	S3	Sub-group 2 (if applicable)

The grouping strategy has considered their traits, levels and in-class performance after consultation with a school teacher. During the lesson, the school teacher was in the classroom so as to provide assistance and help me to monitor the performance of any 1 of these 2 groups during activities time.

Major findings

The project is comprised ten sessions which cover concept of fractions, comparing and addition, it aims at enhancing students' understanding of fraction concepts and better mathematical representation in notation form. There were 7 students involved in this project. The short-term objective is to improve their result in doing fractions, while the long-term objective is to foster an interest in learning mathematics. The overall objectives has been met after reviewing the result of pre-test and post-test and observing students' performance in each session.

Pre-test and Post-test

To reflect the effectiveness of the project, a comparison of each student's performance in pre- and post-test is made; it has shown in the following figure.

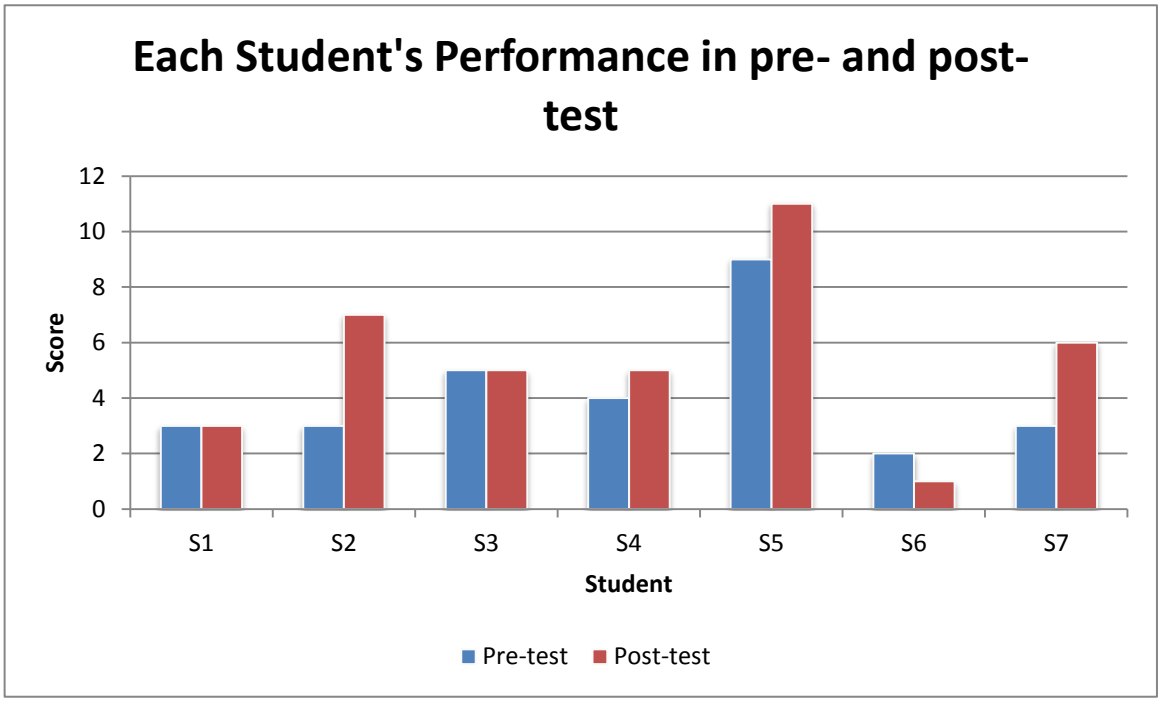


Figure 2

Student Performance before and after 10 sessions

As presented in the **Figure 2**, over half of them (57%) have a definite improvement in the post-test. In addition, two students obtained the same score and one student obtained lower score after the lessons.

By reviewing their answer, some techniques taught in the sessions can be seen on their post-test paper, such as drawing line to divide things into parts according to the denominator in the question, or circling parts based on the numerator in the question (see Appendix F). This can reflect that students learnt some techniques and they were able to use them while doing assessment. The project can be concluded that students have a better performance in doing fractions, which meet the short-term objective of the project, and thus it is a successful teaching package for students.

Questionnaire

Apart from the pre- and post-test, questionnaire was also provided in the first and the last session for students to complete (see Appendix C). The first part, i.e. question 1-10, is about students' perception of fractions, for instance, the interest in learning fractions and its practicality. For the second part, i.e. question 11-20, is about students' perception of the 10 sessions and their performance in the lesson. The data of each student has been summarized in the following figure:

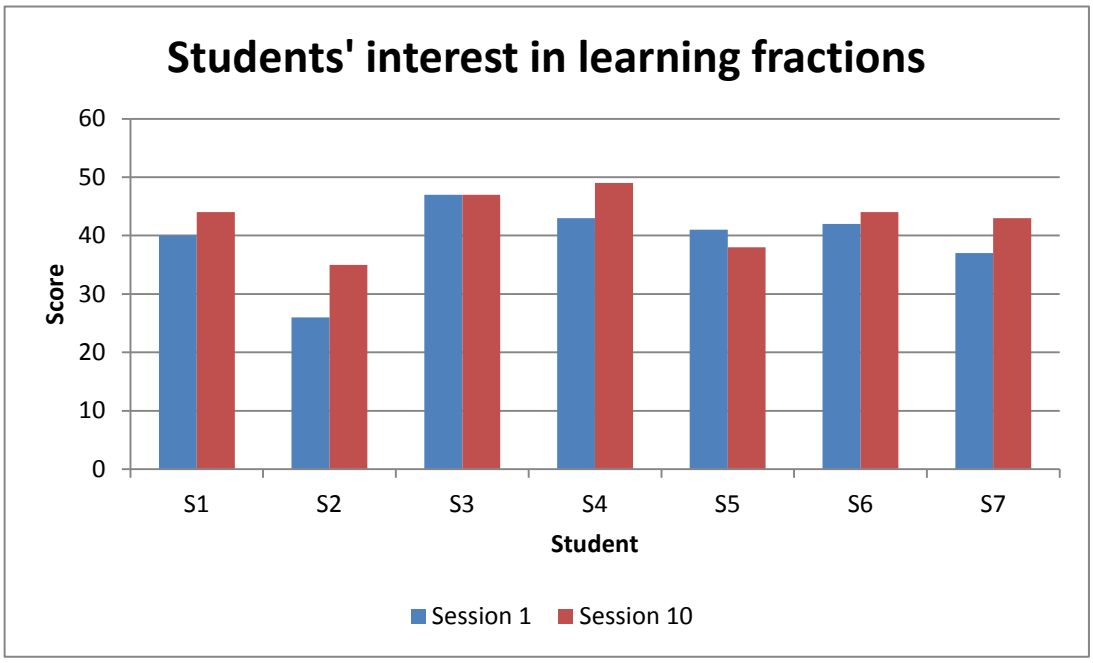


Figure 3

Questionnaire Chart – Session 1 and Session 10 – First Part (Q1-Q10)

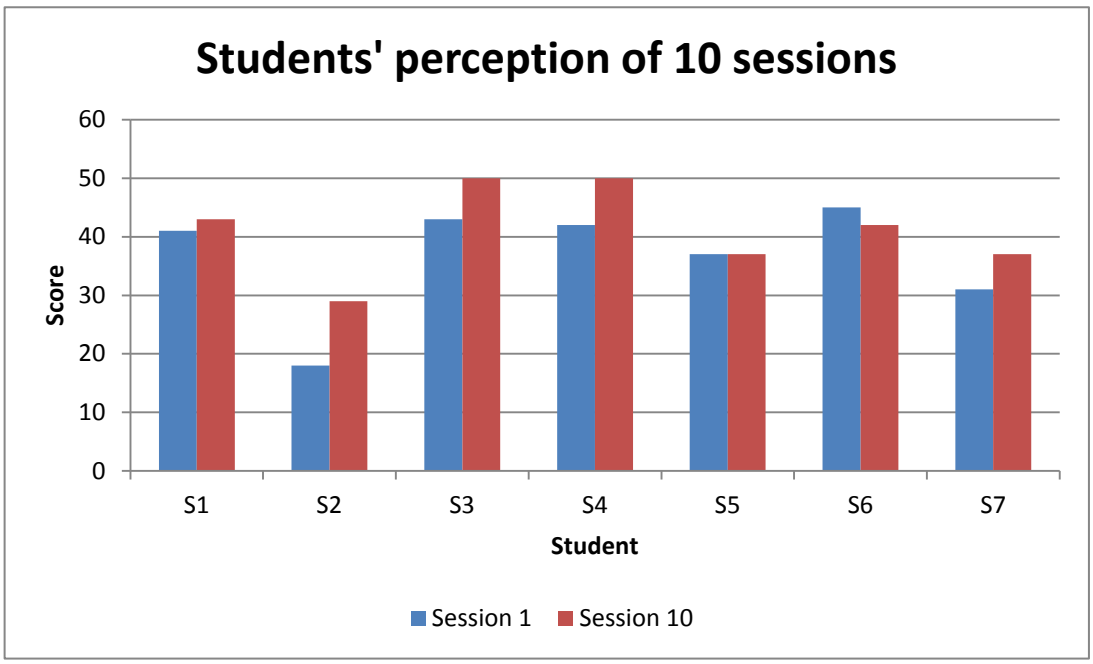


Figure 4

Questionnaire Chart – Session 1 and Session 10 – Second Part (Q11-Q20)

As can be observed from the **Figure 3**, the score on almost of all the students increases, compared to the beginning of this project. A large portion of them increases their interest in fractions and are more willing to doing it, while the score of S5 has a slightly decrease, which means that the learning motivation of her is still low. Overall, the data reflects that the project meets its long-term objective, which is foster students' interest in learning mathematics.

From **Figure 4**, it can be concluded that although S5 reflected this project could not raise her interest and motivation, most participants (71%) considered these 10 sessions were attractive, interesting and practical for solving fraction problems.

Formative assessment

To measure the effectiveness and students' understanding of each lesson, a worksheet with around two to three questions was given to students at the end of each lesson (see Appendix

D). Their understanding of learning contents can be reflected from the result of worksheets, for instance, when students completed the worksheet at the end of session 9, all students obtained full marks. It reflected that they learnt the addition of fractions with same denominator though the activity. However, over half of them got zero mark in the worksheet of session 7, suggesting that they could not manage how to compare three fractions in one lesson; therefore a follow-up had to be added in session 8. Formative assessment is helpful to indicate students' ability and effectiveness of the lesson.

Peer and supervisor feedback

Feedback and reflection form has also been collected from peer, school teacher, supervisor and me to check the effectiveness and teaching design regularly. Feedbacks from peer and supervisor focused on the teaching design and my performance during the lesson. Some changes have been made after receiving their feedbacks, such as consolidation was added at the end of each lesson, and the feasibility and creativity of activities was considered more frequently. Besides, some useful feedbacks were received from the school teacher, who was originally responsible for the after-class tutorial, for example, the way to divide students into groups and their traits and level. It is crucial for me to apply heterogeneous grouping strategies throughout the 10 sessions, the grouping is considered based on their traits and levels so that students can learn from each other. Also, more e-learning was added in the lesson after discussion with school teacher based on the characteristics of the school. The most important function of my reflection form is to record every situation in each session and

any improvement can be made in the future. It acts as a progress report to help adjust the teaching package and record students' performance in the project. Feedbacks from third party and my reflection help me to see the project in a different light when I am revising the teaching package after each session.

Discussion

From the result of pre- and post-test, questionnaire and formative assessment, this project has shown its effectiveness and generally met its short-term and long-term goal, i.e. to improve their result in test and to foster their interest for further fraction learning.

The experience (E) component played an important role in this project. It was observed that there was a common misunderstanding that $\frac{1}{n}$ of a couple of objects equals to 1 among students. It has been explained by assisting with pictures but students could not absorb it, hence scavenger hunt game was introduced in the next lesson in order to explain this concept with the help of physical objects. Indeed, the result was satisfied, and proved that learning fraction concepts with physical action benefits students' learning. This result was consistent to Taylor et al. (2012) who found that students learnt to solve fraction problems faster with objects than pictures. However, if the result is examined thoroughly, some findings are not as well as expected, compared to those previous studies. Some differences between the previous studies and this project and possible reasons are concluded in the below part.

Age difference

From the result of previous researches, it found that students learnt in ELPS framework had a better performance and significant effect than those who in direct learning (Maryono, Rodiah & Syaf, 2021; Nissa, Sanapiah & Yuntawati, 2019). By reviewing of their teaching design and procedure, not an obvious difference has been observed, except the participants' age. Participants of the two studies mentioned above were secondary school students, while participants of this project were primary school students. From in-class observation, one characteristic of those students who obtained the same or lower score after 10 sessions, i.e. S1, S3 and S6, can be concluded that they could not receive important message from the teacher. These students were too eager to play games in activities time, instead of listening to teacher's instruction and explanation about the mathematical concepts behind. Compared to secondary students, younger children from primary school have lower self-discipline; they are harder to control their in-class performance. This may be the reason why some students got noticeable improvement on their test while some got the same score, or even had a slight decrease in the post-test.

Learning motivation

Apart from the teaching design, students' learning attitude and motivation also are a crucial component to affect the results of studies. Gradini and Bahri (2018) demonstrated the effectiveness of teaching tools designed based on ELPS approach in mathematics classroom, they also emphasized that the effectiveness was based on students' responses. If students'

responses to learning were positive, the effectiveness of the teaching tools was more likely to be shown. As recorded in Participants part, not all of the participants had high learning motivation or excited in learning mathematics. Some of them performed indifferent, although they were still act under instructions, the learning attitude was not positive. Hence, this was slightly different from the previous studies, as well as the result.

Limitation and Implication

Suboptimal class size

In the planning stage, the targeted student number of this project is approximately 3-5 students. However, the school that this project took place in has little SEN students, they group all of them into an after-class tutorial group and one teacher is in charge of this tutorial class. As a result, I had to deal with 7 students at the same time. It exceeds the target of participants and the class size is too big for me to conduct small group teaching. Thus, I asked the original school teacher if she can offer help during group activity. So students were divided into a group of 3 and a group of 4, sometimes divided into two sub-groups of 2 if needed, during group activities and each of us was responsible for one group. There was a disadvantage of this method is I missed another group's performance, hence it greatly depended on the communication between school teacher and I. I needed to ask the school teacher if there is anything I needs to know in today's lesson and switched our responsible group frequently, so that I was able to aware of the learning progress of every student.

Large learning difference

The class size of this project is big; meanwhile the learning difference among them is also big. Apart from SpLD, one student diagnosed with ADHD as well, and another student was tested with limited intelligence. Even student diagnosed with SpLD only, their intelligence range has difference that between average and lower average. Therefore, the learning progress can be hugely different among them. To solve the problem, heterogeneous grouping was applied in the lesson. Students with deeper understanding of fractions were grouped with lower level students. Sharing opinions about learning content and explanation was highly encouraged in the lesson, so that students could be a "small teacher" to help me to explain when they were suffering in difficulties. This strategy worked well; they were familiar with and felt comfortable with explaining their opinions to their classmates at the end of this project

Suggestions for further SEN teaching

Concluding the experience of this project, ELPS approach is worth to apply in mathematics lesson and effective to SpLD students. Teacher should emphasize the portion of hands-on experience in their lesson, especially with the assist of physical objects. This highly enhances students' understanding, typically in those abstract concepts. Also, picture should be showed after the experience, it can be a picture or graph found on the internet, or a picture that created by students to represent the experience, both ways can boost their understanding. Similarly, language has the same function; students should be able to explain the mathematics concept behind the hands-on experience. Once they can explain it orally, they can enter the next steps,

i.e. representing the experience and their understanding in mathematics symbols, more easily. These 4 steps are the key to help SpLD students to understand abstract concept.

Conclusion

The 10 sessions in this project aims to help SpLD have a better understanding in basic fractions concept and calculation and then proceed to higher level of fractions calculation. The interest of mathematics also is the main concern of this project. Students' performance has a definite improvement in fractions and it can be observed by their pre- and post-test, formative assessment and in-class performance. They also gain interest in learning mathematics, especially fractions after these 10 sessions, which can be seen in the questionnaire. Despite of the exceeding class size and huge learning difference, ELPS approach shows its effectiveness. As a result, it is a good teaching method and can be widely used in teaching SpLD students. As a school teacher, we should try different teaching methods and find out which is most suitable for our students. Although the time for preparing lessons is tight, it is still the most important task in our teaching life.

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Appendix A – Detail lesson plan

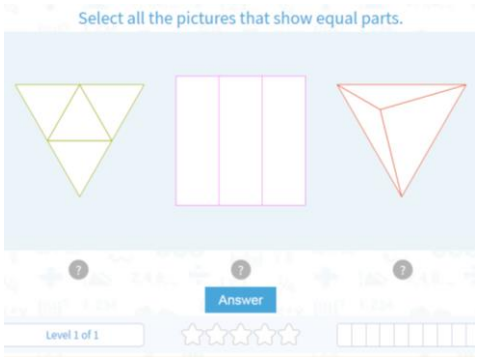
Session 1

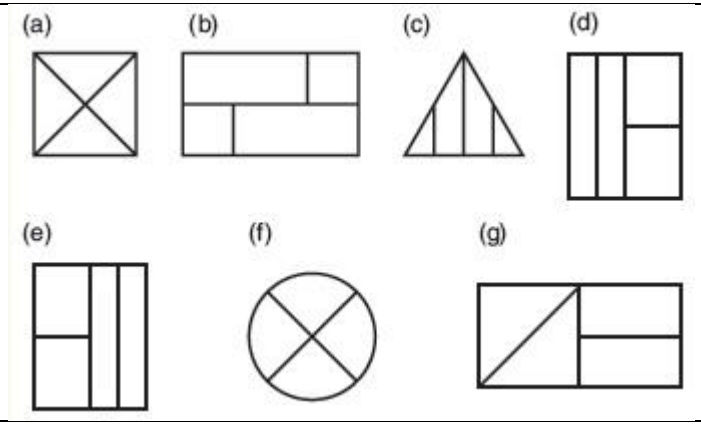
Date:	18/10/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	1/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Understand the concept of fair share
2. Understand fraction is a part of whole (continuous unit)

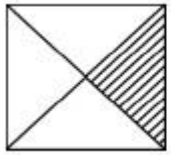
Previous knowledge:
Students know:
1. Use division to express fair share
2. Calculate division

Teaching materials:
1. Pre-test
2. Questionnaire
3. Color pens
4. Papers
5. Assessment
6. PowerPoint

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
20 minutes	• Pre-test & questionnaire	• **Pre-test** Ask students to complete the pre-test in 15 minutes, in order to compare their result in the end of the project. • **Questionnaire** Ask students to complete the questionnaire in 5 minutes, in order to compare their result in the end of the project.	• Pre-test • Questionnaire	
5 minutes	• Revision the concept of fair share	• **Fair share** **E:** use online games to help students understand the concept of fair share  Reference: https://www.mathgames.com/skill/2.5-equal-parts **P:** show pictures below (with fair share examples and non-examples) as a support to help students identify whether they are divided equally	• PowerPoint	• Multi-sensory: tactile (authentic experience, use of electronic device) • Multi-sensory: visual (use of pictures to represent concept)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
				
5 minutes	• To understand fraction is a part of whole (continuous unit)	• **A part of whole (continuous unit)** **E:** paper folding – distribute a paper to students and ask if they can divide the paper as more as they can, and remind them the division must be equal. Next color any one of the region. **L:** use mathematical language to describe the coloring result (i.e. 將一張紙均分成 n 份，其中一份就是整張紙的 $\frac{1}{n}$). **P:** show the same fraction below and ask if they are the same, to show students the fraction will not change even the dividing methods are different.	• Papers • Color pens	• Multi-sensory: tactile (use of color and pictures)

ENHANCING SPLD STUDENTS' FRACTION BY USING ELPS FRAMEWORK

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		  **S:** ask students to use notation $\frac{1}{n}$ to represent their coloring result.		
5 minutes	• Consolidation	• **Consolidation:** a. Revision of the concept of fair share; b. Fractions can express a part of the whole (in one continuous unit) • **Assessment**	• Assessment	

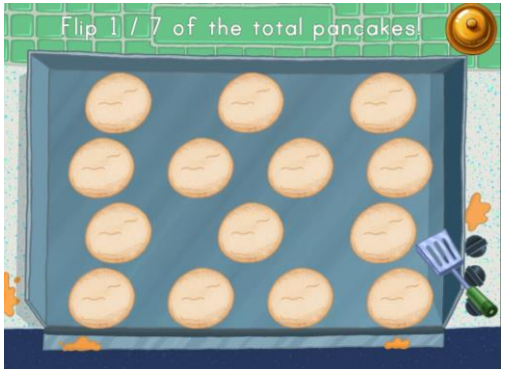
Session 2

Date:	22/10/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	2/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Understand fraction is a part of whole (discrete units)
2. Find the quantity of $\frac{1}{n}$ in a group of things

Previous knowledge:
Students know:
1. Understand fraction is a part of whole (continuous unit)
2. Understand the concept of fair share in fraction

Teaching materials:
1. PowerPoint
2. Stickers
3. Assessment

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
15 minutes	• To understand fraction is a part of whole (discrete units)	• **A part of whole (discrete units)** **E:** use online games to help students understand the meaning of numerator and denominator. Students are required to divide pancakes into different parts, based on the fraction shown in the online games, e.g. $\frac{5}{10}$, $\frac{1}{8}$ etc. in order to understand the meaning of fractions.  Reference: https://www.education.com/game/pancake-fractions/ **L:** ask students to describe the game result in following sentence: A 佔 B 的 $\frac{1}{n}$. **P:** use PowerPoint as a support when students are describing the result.	• PowerPoint	• Multi-sensory: tactile (authentic experience, use of electronic device)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		S: use notation $\frac{1}{n}$ to represent the result.		
15 minutes	• To find the quantity of $\frac{1}{n}$ in a group of things	• **Quantity of $\frac{1}{n}$ (discrete units)** **E:** divide students into groups of two people, teachers then show a fraction on the PowerPoint, students have to divide the stickers according to the fraction shown as fast as possible, the group who complete faster wins. **L:** ask students to describe their action, e.g. "有貼紙x張，$\frac{1}{n}$即有y張". **S:** use numbers to express the quantity of $\frac{1}{n}$ in a group of things in the assessment.	• Stickers • PowerPoint	• Multi-sensory: tactile (use of props) • Collaborative learning
5 minutes	• Consolidation	• **Consolidation:** a. Fractions can express a part of the whole (in discrete units) b. How to find the quantity of $\frac{1}{n}$ in a group of things: First divide things into n parts, then count how the quantity in 1 part. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only write numbers to test their ability)

Session 3

Date:	25/10/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	3/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Use $\frac{1}{n}$ to represent the relationship between certain quantity in a group of things
2. Use $\frac{m}{n}$ to represent the relationship between certain quantity in a group of things

Previous knowledge:
Students know:
1. Fraction is a part of whole
2. Find the quantity of $\frac{1}{n}$

Teaching materials:
1. Fraction picture cards
2. Notation cards
3. PowerPoint
4. iPad
5. Assessment
6.

ENHANCING SPLD STUDENTS' FRACTION BY USING ELPS FRAMEWORK

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
13 minutes	• To use $\frac{1}{n}$ to represent the quantity in a group of things	• **Fraction is a part of whole (discrete units)** **E:** teacher distribute 14 cards to students (7 are fraction cards with picture, and other 7 are fraction notation e.g. $\frac{1}{n}$). Students can flip two cards each time, if the fraction picture and notation matches, students can take those two cards away, if not, they have to put them back. Student who has more cards wins. **L:** when students flip the card, they have to say aloud the fraction, e.g. 七分之一, and explain the fraction in the following sentence: e.g. 有花 12 朵，平均分成 6 份，每份有 2 朵花，$\frac{1}{6}$ 即有2朵花". **P:** use fraction pictures as a support to help students understand the meaning of numerator and denominator, and there can be more than 1 thing in one part. **S:** use notation $\frac{1}{n}$ to represent the quantity in a group of thing in the assessment.	• Fraction picture cards • Notation cards • PowerPoint	• Multi-sensory: tactile (use of props) • Card matching (help students to build up concept visually)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
17 minutes	• To use $\frac{n}{m}$ to represent the quantity in a group of things	• **Fraction are some parts of whole (discrete units)** **E:** divide students into groups of two people, ask students to use different pattern blocks to construct a picture via the online website. Example:  Reference: https://mathigon.org/polypad **L:** teacher can ask students questions related to fraction based on their work, e.g. 藍色的圖形佔全部圖形的幾分之幾？ **P:** use PowerPoint as a support when explaining rules and demonstrating to students. **S:** use notation $\frac{n}{m}$ to represent the quantity in a group of things in the assessment.	• iPad • PowerPoint	• Multi-sensory: tactile (authentic experience, use of electronic device) • Collaborative learning • Gallery walk (encourage students to appreciate other's work)
5 minutes	• Consolidation	• **Consolidation:** a. Fractions can express a part of the whole (in discrete units)	• Assessment	• Foundation tier worksheet (allow students only write

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		b. Fractions can express some parts of the whole (in discrete units) • **Assessment**		numbers to test their ability)

Session 4

Date:	29/10/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	4/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Find the quantity of $\frac{m}{n}$ in a group of things
2. Understand the relationship between 1 and fractions

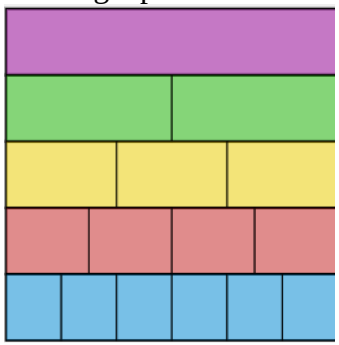
Previous knowledge:
Students know:
1. Use $\frac{1}{n}$ and $\frac{m}{n}$ to represent certain quantity in a group of things
2. Find the quantity of $\frac{1}{n}$

Teaching materials:
1. PowerPoint
2. Rectangle pieces
3. Assessment
4.

Use of whiteboard:

有 ____(物品)_____，
平均分成 _____ 份，
取其中 _____ 份，
即有 ____(數目)____。

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
15 minutes	• To find the quantity of $\frac{m}{n}$ in a group of things	• **Quantity of $\frac{n}{m}$ (discrete units)** **E:** playing scavenger hunt (收買佬) game First teacher divides students into 2 groups, then ask them to collect certain number of an object specified by teacher, e.g. 8支筆. Once students complete collecting, they have to put collected things on teacher's table. The group who is faster wins. **L:** teacher will check the quantity of things, if it is right, then teacher can ask students questions related to fractions, e.g. 8 支筆的 $\frac{3}{4}$ 是多少支？Students have to explain their answers in the following sentence: e.g. 有筆 8 支，平均分成 4 份，取其中 3 份，即有 6 支. If representative of student is difficult to divide things or count the quantity, he can ask his team members for a help. **P:** use PowerPoint as a support to help students understand how to divide things into certain groups and find the quantity of $\frac{m}{n}$ in a group of things. **S:** use numbers to represent the quantity of $\frac{m}{n}$ in a group of things in the assessment.	• PowerPoint	• Multi-sensory: tactile (use of props) • Collaborative learning

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
15 minutes	• To understand the relationship between 1 and fractions	• **Relationship between 1 and fractions** **E:** the original rectangle (purple one) is divided into different parts (i.e. green, yellow, pink and blue one) and distributed to students; they have to place the same color pieces together to become a whole rectangle again. Rectangle pieces:  **L:** teacher can ask students a rectangle is divided into how many pieces? Students' expected answers: e.g. a rectangle is divided into 4 pink pieces. Then teacher can further explain each piece represent $\frac{1}{4}$ rectangle, 4 pink pieces equal to a whole rectangle, so 4個 $\frac{1}{4} = \frac{4}{4} = 1$ It is important to guide students understand that: 1) each part is $\frac{1}{n}$ of the whole rectangle 2) n parts of $\frac{1}{n}$ part equals to 1 whole rectangle	• Rectangle pieces	• Multi-sensory: tactile (use of props)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		S: use notation to represent the relationship between 1 and fractions in the assessment.		
5 minutes	• Consolidation	• **Consolidation:** a. How to find the quantity of $\frac{n}{m}$ in a group of things: First divide things into m parts, then count the quantity in n parts. b. Relationship between 1 and fractions: 1 = n 個 $\frac{1}{n}$. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only write numbers to test their ability)

Session 5

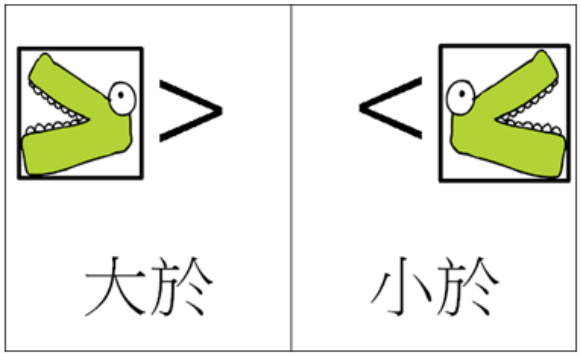
Date:	8/11/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	5/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Identify and use >, < symbols correctly
2. Compare fractions with same denominator

Previous knowledge:
Students know:
1. Use fractions to express the quantity in one "whole" thing
2. Use fractions to express the quantity in a group of things
3. Identify and use >, < symbols correctly

Teaching materials:
1. PowerPoint
2. Alligator game set
3. Grid papers (5x5, 6x6)
4. Assessment
5. Definition reminders
6. Color pens

Use of whiteboard:

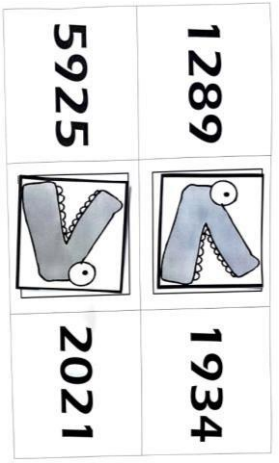


比較同分母分數時，

分數的**分子愈大**，

它的**數值愈大**

ENHANCING SPLD STUDENTS' FRACTION BY USING ELPS FRAMEWORK

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
15 minutes	• Revision of > and < symbols	• **Revision of > and < symbols** **E:** use alligator game set to help students revise the meaning of > and < symbols. These are some game rules: a. Students should use Blu Tack to stick the correct symbols into the right place on the worksheet. b. Each team member needs to take turns to complete the questions. c. When members are answering, the others should keep quiet and wait patiently for their turns, if members are doing wrong, the others can remind them the correct answer. When students are able to answer the meaning of > and < symbols correctly, teacher stick the definition of > and < symbols on the whiteboard as a reminder. **L:** ask students to use mathematical language to describe the game result, e.g. 9 大於 7. **S:** ask students to use > and < symbols correctly in the assessment.	• Alligator gameset  (student's work example)	• Multi-sensory: tactile (use of props) • Heterogeneous grouping (allow students learn from the others)
15 minutes	• To compare fractions with same denominator	• **Compare fractions with same denominator** **E:** color grid papers to help students compare fractions with same denominator There are 2 rounds, in the first round teacher distributes 5×5 grid paper to each student and asks them to color in	• Grid papers • Color pens • PowerPoint	• Multi-sensory: tactile (use of props) • Multi-

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		different numbers of grids, e.g. 16. After coloring, teacher asks students to write down what fraction of the grid papers is colored, e.g. $\frac{16}{25}$. **Introducing fractions with the same denominator:** Then teacher let students to discover the similarities of these three fractions, students should be able to find that they have the same denominator, then teacher can explain that fraction having the same denominator are called fractions with the same denominator. **Compare fractions with the same denominator:** Teacher let students to compare the colored area and find out which one is bigger, then teacher can explain that when comparing fractions with the same denominator, the greater the numerator, the greater the fraction, and stick the meaning on the whiteboard. For the second round, teacher distributes 6×6 grid paper to each group and asks them to color in different numbers of grids. In this round, teacher will ask students to write down the fractions and compare the three fractions by themselves. **L:** teacher should ask the following questions and let students use mathematical language to describe the experience: a. How many grids are there in the grid paper? Expected answers: 25 or 36.		sensory: visual (use of colors to represent abstract concept) • Gallery walk (encourage students to appreciate other's work)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		b. How many grids are colored in the grid paper? E.g. 16. c. What is the fraction of the grid papers is colored? E.g. $\frac{16}{25}$. d. Which colored area is bigger? e. Hence, which fraction is greater? And why? **P:** use projector to show students' work (coloring result) as a support when students are describing the experience. **S:** ask students to use > and < symbols to compare fractions in the assessment, e.g. $\frac{8}{25} > \frac{6}{25}$.		
5 minutes	• Consolidation	• **Consolidation:** a. Revision of the meaning of > and < symbols; b. Fractions having the same denominator are called fractions with the same denominator; c. When comparing fractions with the same denominator, the greater the numerator, the greater the fraction. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only circle the correct answers and write symbols to test their ability)

Session 6

Date:	15/11/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	6/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Compare fractions with same numerator

Previous knowledge:
Students know:
1. Use fractions to express the quantity
2. Compare fractions with same denominator

Teaching materials:
1. PowerPoint
2. Grid papers (5x5, 6x6)
3. Assessment
4. Color pens

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
5 minutes	• Revision of comparing fraction with same denominator	• **Revision of comparing fraction with same denominator** **L:** teacher can ask the following questions during revision to build up short-term memory, e.g. what is fraction with same denominator? How can we compare fraction with same denominator? **P:** use PowerPoint to show students' work in last lesson as a support to help students understand when comparing fractions with same denominator, the greater the numerator, the greater the fraction, **S:** ask students to use > and < symbols to compare fractions with same denominator in the assessment.	• PowerPoint	• Multi-sensory: visual (use of pictures and to represent concept)
25 minutes	• To compare fractions with same numerator	• **Compare fractions with same numerator** **L:** teacher can ask whether $\frac{1}{2}$ or $\frac{1}{3}$ is greater and ask students to explain their answer. **E:** color grid papers to help students compare fractions with same numerator. There are 2 rounds, in the first round teacher distributes a group one 5×5 grid paper and the other group one 6×6 grid paper. Then ask them to color the same number of grids, e.g. color 6 grids. After coloring, teacher asks students to write down what fraction of the grid papers is colored, e.g. $\frac{6}{25}$.	• Grid papers • Color pens • PowerPoint	• Multi-sensory: tactile (use of props) • Multi-sensory: visual (use of colors to represent abstract concept) • Gallery walk (encourage

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		Introducing fractions with the same numerator: Then teacher let students to discover the similarities of these three fractions, students should be able to find that they have the same numerator, then teacher can explain that fraction having the same numerator are called fractions with the same numerator. **Compare fractions with the same numerator:** Teacher let students to compare the colored area and find out which one is bigger, then teacher can explain that when comparing fractions with the same numerator, the greater the denominator, the greater the fraction. In the second round, teacher will ask students to write down the fractions and compare the fractions by themselves. **L:** teacher can ask the following questions to help students understanding how to compare fractions with same numerator and let them use mathematical language to describe the experience: How many grids are there in the grid paper? Expected answers: 25 or 36. How many grids are colored in the grid paper? E.g. 6. c. What is the fraction of the grid papers is colored? E.g. $\frac{6}{25}$.. Which colored area is bigger?		students to appreciate other's work)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		Hence, which fraction is greater? And why? **P:** use projector to show students' work (coloring result) as a support when students are describing the experience. **S:** ask students to use > and < symbols to compare fractions with same numerator in the assessment.		
5 minutes	• Consolidation	• **Consolidation:** a. Fractions having the same numerator are called fractions with the same numerator; b. When comparing fractions with the same numerator, the greater the denominator, the greater the fraction. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only write numbers to test their ability)

Session 7

Date:	19/11/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	7/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Compare three fractions with different denominator and numerator

Previous knowledge:
Students know:
1. Compare fractions with same denominator
2. Compare fractions with same numerator

Teaching materials:
1. PowerPoint
2. Fraction cards
3. Assessment

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
5 minutes	• Revision of comparing fraction with same denominator or numerator	• **Revision of comparing fraction with same denominator or numerator** **L:** teacher can ask the following questions during revision to build up short-term memory: (a) What is fraction with same denominator? How can we compare fraction with same denominator? (b) What is fraction with same numerator? How can we compare fraction with same numerator? **P:** use PowerPoint as a support to help students understand when comparing fractions with same denominator, the greater the numerator, the greater the fraction. While comparing fractions with same numerator, the greater the denominator, the greater the fraction. **S:** ask students to compare fractions in the assessment.	• PowerPoint	
25 minutes	• To compare three fractions with different denominator and numerator	• **Compare three fractions** **E:** teacher divides students into groups of 2 people, and then distributes 3 cards with fraction on it to each group. Teacher introduce the steps of comparing three fractions: (a) First, pick out fractions with same denominator, and compare which is greater, the greater one can put on the right hand side. (b) Then, observe which two fractions with same numerator, and compare which is greater, the greater one can put on the right hand side.	• Fraction cards	• Multi-sensory: tactile (use of props) • Task analysis (Break long and complicated strategy into smaller steps)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		Teacher should remind students to pay attention to the >, < symbols requested in the questions. Once students get familiar to the comparing steps, teacher can provide less assistance, e.g. teacher can only revise the steps before students start to work on it, and then check the result after completion. **L:** teacher can lead students to think about how to compare three fractions, e.g. how can we compare three fractions? Is there any similarity between three fractions? If yes, which step should we do first? **S:** ask students to compare three fractions in the assessment.		
5 minutes	• Consolidation	• **Consolidation:** a. Comparing three fractions: First, compare fractions with the same denominator. Then compare fractions with the same numerator, and combine the result. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only write fractions to test their ability)

Session 8

Date:	26/11/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	8/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Understand equivalent fractions

Previous knowledge:
Students know:
1. Use fractions to express the quantity
2. Understand the relationship between 1 and fractions

Teaching materials:
1. Worksheet
2. Assessment

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
30 minutes	• To understand equivalent fractions	• **Equivalent fractions** **E:** there are 6 columns in the first part, teacher can ask students to choose 2 columns out of 6, and then color half of the rectangle at each column. For example, student chooses to column the second column, the rectangle is cut into 4 pieces, and then he/she has to color two of them, so half of the rectangle is colored. After coloring, teacher asks students to write their fractions next to the column. Then teacher can display their work on the projector and let them to discover the similarities between those colored regions. They should be able to discover that e.g. $\frac{1}{2} = \frac{5}{10}$. For the second and third round, teacher can let students to decide which fractions they want to write and color. In the last round, teacher can introduce the relationship between 1 and fractions again. **L:** teacher asks students to describe their findings, e.g. $\frac{1}{2} = \frac{5}{10}$. **P:** use projector to show students' work (coloring result) as a support to help students understand the concept of equivalent fractions. **S:** ask students to write equivalent fractions in the assessment.	• Worksheet • Color pens	• Multi-sensory: tactile (use of props) • Multi-sensory: visual (use of colors to represent abstract concept) • Gallery walk (encourage students to appreciate other's work)
5	• Consolida	• **Consolidation:**	• Assessment	• Foundation

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
minutes	tion	a. Fractions that are equal in value are called equivalent fractions, e.g. $\frac{1}{2} = \frac{5}{10}$. • **Assessment**		tier worksheet (allow students only write fractions to test their ability)

Session 9

Date:	29/11/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	9/10

Learning objectives:
At the end of this lesson, students should be able to:
1. Calculate addition of fractions with same denominator

Previous knowledge:
Students know:
1. Use fractions to express the quantity
2. Understand the relationship between 1 and fractions
3. Fractions with same denominator

Teaching materials:
1. Worksheet
2. iPad
3. Assessment

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
30 minutes	• To calculate addition of fractions with same denominator	• **Addition of fractions with same denominator** **First round:** **E:** divide students into groups of two people; ask students to use different pattern blocks to construct a picture via the online website. There are some rules: they are only allowed to use not more than five types of colors or figures, but the total number of figures is not limited. Example:  (total 5 types of figures & colors) Reference: https://mathigon.org/polypad **L:** teacher can ask students the following questions: (a) How many figures have you used in the picture? (b) How many different types of colors or figures have you used in the picture? **P:** use projector to show students' work as a support when demonstrating to students. **S:** after students answer the questions, teacher can ask students to write down what fraction of each color or figures is in the picture on the worksheet, and then teacher	• Worksheet • iPad	• Multi-sensory: tactile (authentic experience, use of electronic device) • Collaborative learning • Gallery walk (encourage students to appreciate other's work)

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		can guide students to calculate the addition of two fractions with same denominator and complete the first page of the worksheet. **Second round:** In the second round, students can create another picture to complete the second page of the worksheet, the rules and steps are as same as the first round except there is one more questions at the bottom. Students are required to calculate all fractions mentioned above, e.g. $\frac{5}{10} + \frac{3}{10} + \frac{2}{10} = \frac{10}{10} = 1$.		
5 minutes	• Consolidation	• **Consolidation:** a. Revise the concept of addition of fractions with same denominator, e.g. $\frac{5}{10} + \frac{3}{10} = \frac{8}{10}$. • **Assessment**	• Assessment	• Foundation tier worksheet (allow students only write fractions to test their ability)

Session 10

Date:	3/12/2021	**Time:**	12:50 – 13:25 (35 minutes)
Grade:	P4	**Number of students:**	7
Topic:	Fractions	**Lesson in unit:**	10/10

Learning objectives:

1. Revision of the knowledge taught in the previous 9 sessions

Previous knowledge:

Students know:

1. Use fractions to express the quantity
2. Find the quantity of $\frac{1}{n}$ and $\frac{m}{n}$
3. Compare fractions
4. Understand equivalent fractions
5. Calculate addition of fractions with same denominator

Teaching materials:

1. Broad game set
2. Broad game questions
3. Die
4. Post-test
5. Questionnaire

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
20 minutes	• Revision	• **Fraction broad game** **E:** revise knowledge learned in the previous 9 sessions via broad game. Game rules: First divide students into two groups. There are no. 1-5 printed on the game cardboard. When students arrive "1", they have to answer a fraction–related question that draw from question bank "1". If their answer is correct, they can get 1 mark, if not, 0 mark. Students take turns rolling the dice. At the end of the game, student who scores higher wins. Broad game cardboard reference: https://lifeovercs.com/free-addition-facts-game/ **L:** students are required to say aloud their answers to their team members, and then team members have to check if his/her answer is correct. If not, they can try to answer the question and explain it. **P:** pictures are shown on the question card in most of the cases to help students have a better concept of the questions.	• Broad game set • Broad game questions • Die	• Multi-sensory: tactile (use of props in game) • Heterogeneous grouping (allow students learn from the others)
15 minutes	• Post-test & questionnaire	• **Post-test** Ask students to complete the post-test in 10 minutes, in order to compare their result in the end of the project.	• Post-test • questionnaire	

Time	Learning objectives	Activities	Materials (with pictures if needed)	Accommodation to cater needs of SpLD
		• **Questionnaire** Ask students to complete the questionnaire in 5 minutes, in order to compare their result in the end of the project.		

Appendix B – Pre-test & Post-test

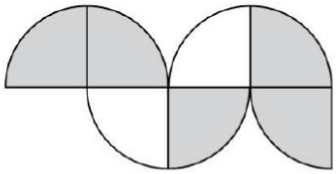
課堂小測驗 (分數)

姓名：_____ (　　)　　填寫日期：_____

班別：_____　　前測 / 後測

我們在課堂已學會了甚麼是分數和分數的加法，試試完成以下的挑戰！

1. 下圖陰影部分佔全圖的幾分之幾？



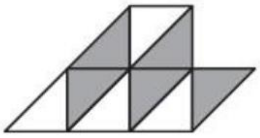
○ A. $\frac{2}{7}$

○ B. $\frac{2}{5}$

○ C. $\frac{3}{5}$

○ D. $\frac{5}{7}$

2. 下圖陰影部分佔全圖的幾分之幾？



○ A. $\frac{3}{7}$

○ B. $\frac{4}{9}$

○ C. $\frac{5}{9}$

○ D. $\frac{4}{5}$

3. 冰箱裏有 10 杯雪糕，其中 $\frac{2}{5}$ 是香草雪糕，3 杯是朱古力雪糕。

(a) 朱古力雪糕佔全部雪糕的 $\frac{\square}{\square}$ 。

(b) 香草雪糕有_____杯。

4. 桌子上有 8 杯飲品，果汁佔全部飲品的 $\frac{3}{4}$，其餘的是牛奶。

(a) 桌子上有_____ 杯果汁。

(b) 牛奶佔全部飲品的 $\frac{\square}{\square}$ 。

5. 6 * 小於 / 等於 / 大於 $\frac{6}{6}$。

(*圈出答案)

6. 在空格內填上適當的數字。

$\frac{\square}{11}$ 比 $\frac{5}{11}$ 大。

7. 桌子上有一包手工紙。明明取去全部的 $\frac{1}{5}$，寶寶取去全部的 $\frac{1}{6}$，玲玲取去全部的 $\frac{1}{3}$。

   * 明明 / 寶寶 / 玲玲 取去的手工紙最少。
   (*圈出答案)

8. 把下列分數由大至小排列。

   $\frac{3}{8}$, $\frac{1}{8}$, $\frac{3}{4}$

   答案：□ , □ , □

   (最大) (最小)

9. 在空格內填上正確的數字。

   $$\frac{5}{12} = \frac{25}{\square}$$

10. 快樂小學上午的上課時間是 $\frac{7}{12}$ 小時，下午的上課時間是 $\frac{4}{12}$ 小時，而午膳時間是 $\frac{5}{12}$ 小時。

    快樂小學每天的上課和午膳時間共 □ 小時。

Appendix C – Questionnaire

學習動機問卷

姓名：_____(　　)　　填寫日期：_____

班別：_____　　前測 / 後

這份問卷邀請你描述對分數的學習動機，若你認為某題目敘述與你的狀況**完全相符**，請圈選 5；若題目敘述與你的狀況**完全不符**，請圈選 1；若題目與你的狀況部分相符，請圈選適當數字。

第一部分		完全不同意	少部分同意	部分同意	大部分同意	完全同意
1.	我很想學習計算分數。	1	2	3	4	5
2.	我對學習計算分數感到興趣。	1	2	3	4	5
3.	我覺得學習計算分數很有趣。	1	2	3	4	5
4.	我覺得學習計算分數很實用。	1	2	3	4	5
5.	學習計算分數與我的生活息息相關。	1	2	3	4	5
6.	學習計算分數對我有幫助。	1	2	3	4	5
7.	我計劃專注於學習計算分數。	1	2	3	4	5
8.	我打算努力學習計算分數。	1	2	3	4	5
9.	我將花時間在學習計算分數上。	1	2	3	4	5
10.	我的目標是學習計算分數。	1	2	3	4	5

第二部分 - 有關我的表現或課堂		完全不同意	少部分同意	部分同意	大部分同意	完全同意
11.	我認為課堂很吸引我。	1	2	3	4	5
12.	我想參與課堂。	1	2	3	4	5
13.	我在課堂上已盡力做到最好。	1	2	3	4	5
14.	我認為課堂的資訊很重要。	1	2	3	4	5
15.	我想學習這些資訊以供自己使用。	1	2	3	4	5
16.	我很幸運。	1	2	3	4	5
17.	我認為課堂很簡單。	1	2	3	4	5
18.	我很擅長這類的任務。	1	2	3	4	5
19.	我已學懂了很多關於計算分數的知識。	1	2	3	4	5
20.	我知道學習計算分數的最佳方法	1	2	3	4	5

Appendix D – Formative assessment

分數
第一堂小測驗

姓名：_____(　)　　填寫日期：_____
班別：_____

這份問卷邀請你在**完成這節課堂後**描述對分數的學習動機，若你認為某題目敘述與你的狀況**完全相符**，請圈選 5；若題目敘述與你的狀況**完全不符**，請圈選 1；若題目與你的狀況部分相符，請圈選適當數字。

		完全不同意	少部分同意	部分同意	大部分同意	完全同意
1.	我認為計算分數很簡單。	1	2	3	4	5
2.	我對學習計算分數很有興趣。	1	2	3	4	5
3.	我很想學習計算分數。	1	2	3	4	5
4.	我覺得這節的課堂內容很有趣。	1	2	3	4	5
5.	我覺得這節的課堂內容與我的生活息息相關。	1	2	3	4	5
6.	我覺得這節的課堂內容對我有幫助。	1	2	3	4	5
7.	我喜歡這節的課堂內容和遊戲。	1	2	3	4	5
8.	這節課堂後，我打算努力學習計算分數。	1	2	3	4	5
9.	這節課堂後，我將花時間在學習計算分數上。	1	2	3	4	5
10.	這節課堂後，我發現了自己對分數不熟悉的地方。	1	2	3	4	5

分數
第二堂小測驗

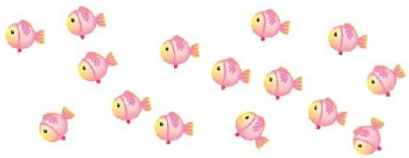
姓名：_____(　)　　填寫日期：_____
班別：_____

我們剛剛學完分數表示一組物件的部分，試試完成以下的挑戰！

藍色保齡球瓶佔全部的 $\frac{(\quad)}{(\quad)}$ 。

綠色保齡球瓶佔全部的 $\frac{(\quad)}{(\quad)}$ 。

我們也學過找出一個數量中某個分數的值，試試完成以下的挑戰！

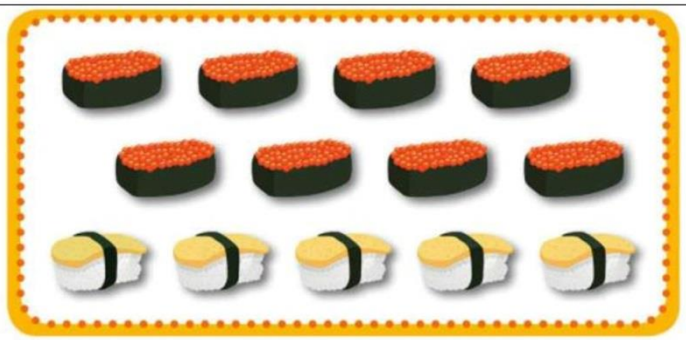


15 的 $\frac{1}{5}$ 是 $\square$ 。

15 的 $\frac{1}{3}$ 是 $\square$ 。

分數
第三堂小測驗

姓名：_____(　)　　日期：_____
班別：_____



全部壽司有 _____ 件。

 佔全部壽司的 ☐ 。(請填上分數)

 佔全部壽司的 ☐ 。(請填上分數)

分數
第四堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

我們剛剛學完找出一個數量中某個分數的值，試試完成以下的挑戰！

例如：8 的 $\frac{1}{2}$ 是 4

10 的 $\frac{4}{5}$ 是 ☐ 。

我們也學過分數與 1 的關係，試試完成以下的挑戰！

$$\frac{(\ \ )}{2} = \frac{(\ \ )}{(\ \ )} = \frac{8}{(\ \ )} = 1$$

分數
第五堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

我們剛剛學會**分母相同**的分數，可稱為**同分母分數**，試把下面的同分母分數圈起來！

例如：$\frac{2}{6}$ 和 $\frac{4}{6}$

$\frac{4}{8}$　　$\frac{4}{7}$　　$\frac{5}{8}$

$\frac{5}{6}$　　$\frac{1}{8}$

我們也學會比較同分母分數時，分數的**分子愈大**，它的**數值愈大**！
試試在下列的空格內，
填上 > 或 < 的符號。

$\frac{4}{17}$ □ $\frac{15}{17}$

$\frac{10}{13}$ □ $\frac{5}{13}$

分數
第六堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

我們剛學會了比較**同分子分數**時，
分數的**分母愈大**，它的**數值愈小**！
試試在下列的空格內，
填上 > 或 < 的符號。

$\frac{2}{8} \square \frac{7}{8}$	$\frac{3}{6} \square \frac{3}{10}$
$\frac{5}{13} \square \frac{5}{9}$	$\frac{10}{13} \square \frac{10}{20}$

分數
第七堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

試試在下列的空格內，
填上適當的分數。

試把 $\frac{4}{7}$、$\frac{4}{17}$、$\frac{6}{7}$ 由小至大排列出來：

_____ < _____ <_____

試把 $\frac{7}{9}$、$\frac{3}{11}$、$\frac{7}{11}$ 由小至大排列出來：

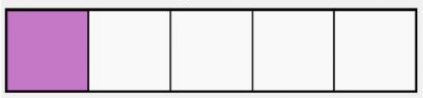
_____ < _____ <_____

分數
第八堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

我們剛學會了等值分數，
試試在下列的空格內，
填上適當的分數或數字。

下圖中，着色部分佔整個圖形的 $\frac{1}{5}$ 。



觀察下圖，寫出 $\frac{1}{5}$ 的等值分數。

$\frac{1}{5} = \square = \square$

在空格內填寫適當的數，使各分數的數值等於 1。

$$1 = \frac{\square}{9} = \frac{20}{\square}$$

分數
第九堂小測驗

姓名：_____(　)　　日期：_____
班別：_____

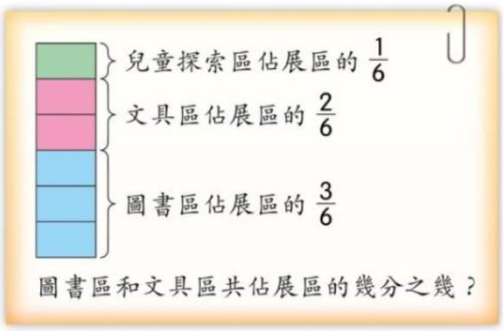
我們剛學會了同分母分數的加法，
試試在下列的空格內，
填上適當的分數或數字。

1. 家裡有 9 個水果。

蘋果和橙共佔全部水果的幾分之幾？

$$\frac{\square}{9} + \frac{\square}{9} = \square$$

2. 書展設有不同的展區。



$$\frac{\square}{6} + \frac{\square}{6} = \square$$

Appendix E – Peer and supervisor feedbacks

Supervisor feedback on session 3:

Supervisor feedback form

Student: ____ _____ **Supervisor:** _ _____

Criteria on "Content"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Identify the teaching/service targets' characteristics and needs clearly and thoroughly in multi-perspectives • Integrate with the key components of teaching/service and discipline specific knowledge substantially • Address on the benefits to the teaching/service targets substantially • Link up with the learning objectives thoroughly in a concise manner • Link to the learning objectives in a comprehensive and thorough manner • Demonstrate full applicability of knowledge (generic and professional) acquired in the university to the project	1.It is not clear how the ELPS framework is used in the lesson plans 2. The lesson plan is too simple. It is advised to add pictures, instructions, and time. 3. there is no consolidation	6
Criteria on "Feasibility"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Highly suitable to the children • Smooth in the flow to deliver the teaching/service with all-rounded consideration in multi-perspectives • Arrangement of teaching/service project with thorough consideration of individual's professional knowledge and generic competences	1. Task analysis-break down tasks 2. Highlight keywords	7

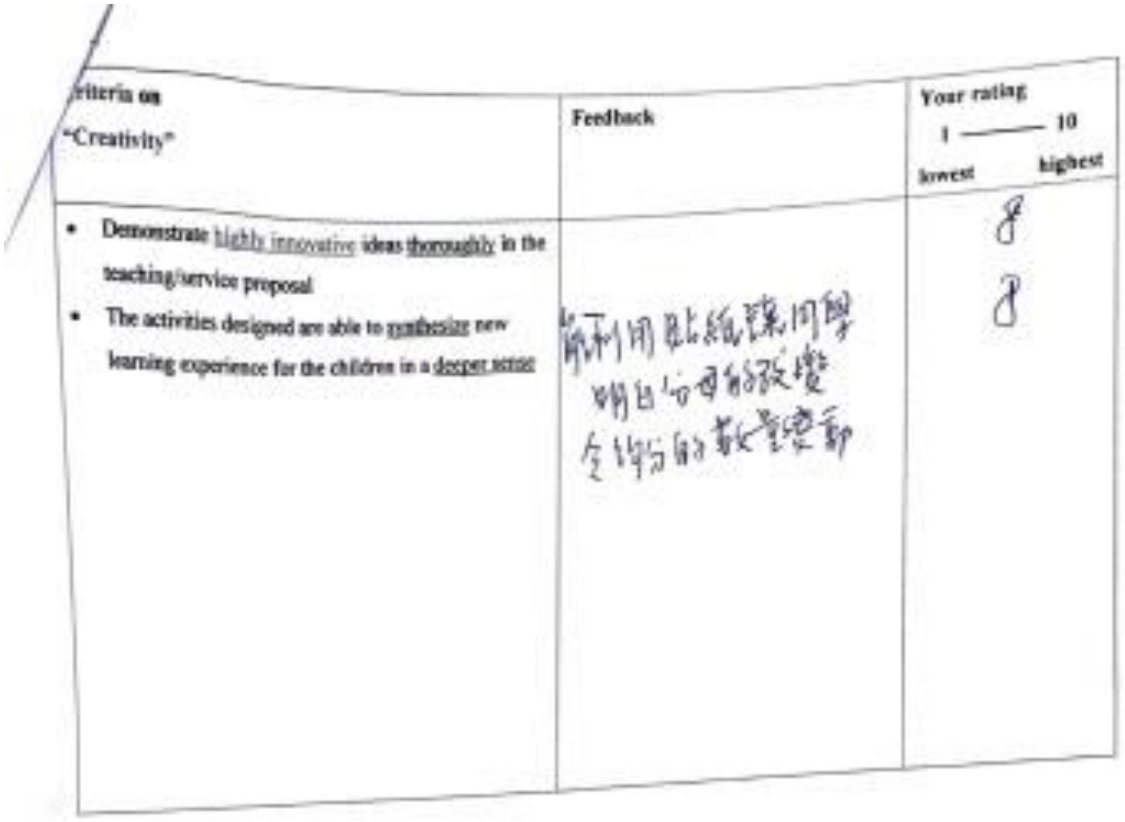
Criteria on "Creativity"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Demonstrate highly innovative ideas thoroughly in the teaching/service proposal • The activities designed are able to synthesize new learning experience for the children in a deeper sense	The use of ELPS in match teaching is innovative. However, it is not clear how it is applied. For example, how four elements (experience with physical object, spoken language to describe experience, pictures to present experience visibly, and written symbols to represent knowledge) are implemented	6.5

School teacher feedback on session 3:

Peer feedback form

Student: _____ Peer: _____

Criteria on "Content"	Feedback	Your rating 1 ——— 10 lowest highest
• Identify the teaching/service targets' characteristics and needs clearly and thoroughly in multi-perspectives • Integrate with the key components of teaching/service and discipline specific knowledge substantially • Address on the benefits to the teaching/service targets substantially • Link up with the learning objectives thoroughly in a concise manner • Link to the learning objectives in a comprehensive and thorough manner • Demonstrate full applicability of knowledge (generic and professional) acquired in the university to the project	老師有利用統學評估，口頭提問去檢定學生的不同能力 老師能緊扣當日課堂目標，循循善誘教導學生	8 8 8 8 8 8
Criteria on "Feasibility"	**Feedback**	**Your rating 1 ——— 10 lowest highest**
• Highly suitable to the children • Smooth in the flow to deliver the teaching/service with all-rounded consideration in multi-perspectives • Arrangement of teaching/service project with thorough consideration of individual's professional knowledge and generic competences	老師有照顧能力較弱的同學，引導他們理解抽象概念	8 8 8



Criteria on "Creativity"	Feedback	Your rating 1 —— 10 lowest highest
• Demonstrate highly innovative ideas thoroughly in the teaching/service proposal • The activities designed are able to synthesize new learning experience for the children in a deeper sense	能利用肥皂泡讓同學明白分母的改變會怎樣影響數量變動	8 8

ENHANCING SPLD STUDENTS' FRACTION BY USING ELPS FRAMEWORK

Supervisor feedback on session 5:

Supervisor feedback form

Student: ___ _____ **Supervisor:** _ _____

Criteria on "Content"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Identify the teaching/service targets' characteristics and needs clearly and thoroughly in multi-perspectives • Integrate with the key components of teaching/service and discipline specific knowledge substantially • Address on the benefits to the teaching/service targets substantially • Link up with the learning objectives thoroughly in a concise manner • Link to the learning objectives in a comprehensive and thorough manner • Demonstrate full applicability of knowledge (generic and professional) acquired in the university to the project	The lesson plan and course delivery have be improved a lot compared to the last supervision. For the first task, teacher should introduce or review the concept "< ", " > " more clearly, and demonstrate how to use them before the group activities.	8
Criteria on "Feasibility"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Highly suitable to the children • Smooth in the flow to deliver the teaching/service with all-rounded consideration in multi-perspectives • Arrangement of teaching/service project with thorough consideration of individual's professional knowledge and generic competences	1. Highlight the keywords 2. 'laminated worksheets' should be used. For example, for the first group tasks, different worksheets could be given to students with different abilities. 3. How you divided them into small groups should be described in the lesson plan	8

Criteria on "Creativity"	**Feedback**	**Your rating** 1 ———— 10 lowest highest
• Demonstrate highly innovative ideas thoroughly in the teaching/service proposal • The activities designed are able to synthesize new learning experience for the children in a deeper sense	The use of ELPS in math teaching is innovative. It is good that the lesson plan has been rearranged based on the ELPS. Advice: 1） The teacher could signify the concept for students to memorize. For example, "alligator always eats big number" so that they know how to use them. 2) Task analysis should be used. For example, the students could conclude the steps for comparing fractions with the same denominator as they may have poor memory. 3) The activities could be designed more interesting. For example, for the second group activities, the teacher could act like "< "， or "> ", and ask two groups (such as one student from group 1 and one student from group 2) to stand at left or right side of the teacher with the worksheet. Other students could judge whether they are at the right position.	8

Peer feedback on session 5:

Peer feedback form

Student: _ **_____** **Peer: ____** **_____**

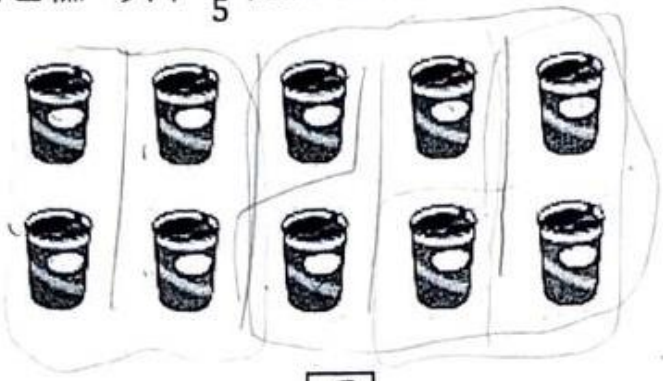
Criteria on "Content"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Identify the teaching/service targets' characteristics and needs clearly and thoroughly in multi-perspectives • Integrate with the key components of teaching/service and discipline specific knowledge substantially • Address on the benefits to the teaching/service targets substantially • Link up with the learning objectives thoroughly in a concise manner • Link to the learning objectives in a comprehensive and thorough manner • Demonstrate full applicability of knowledge (generic and professional) acquired in the university to the project	The first activity is a good activity for revision but may be spend too much time on it.	7
Criteria on "Feasibility"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Highly suitable to the children • Smooth in the flow to deliver the teaching/service with all-rounded consideration in multi-perspectives • Arrangement of teaching/service project with thorough consideration of individual's professional knowledge and generic competences	Both activities are easy to follow, and instructions are clear. Students can understand math concept right after their activities.	9

Criteria on "Creativity"	**Feedback**	**Your rating** 1 ——— 10 **lowest highest**
• Demonstrate highly innovative ideas thoroughly in the teaching/service proposal • The activities designed are able to synthesize new learning experience for the children in a deeper sense	Both activities are multi-sensory, and encourage students involve in learning, everyone can show their ability. Also it can encourage students learn to appreciate others.	8

Appendix F – Post-test paper examples

Example 1:

3. 冰箱裏有 10 杯雪糕，其中 $\frac{2}{5}$ 是香草雪糕，3 杯是朱古力雪糕。

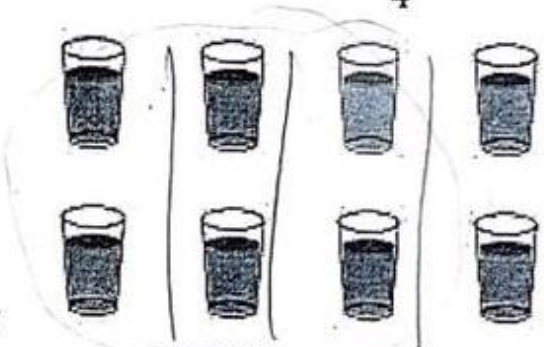


(a) 朱古力雪糕佔全部雪糕的 $\frac{3}{10}$。

(b) 香草雪糕有 4 杯。

Example 2:

4. 桌子上有 8 杯飲品，果汁佔全部飲品的 $\frac{3}{4}$，其餘的是牛奶。



(a) 桌子上有 6 杯果汁。

(b) 牛奶佔全部飲品的 $\frac{2}{8}$。