



賽馬會「知優致優」計劃

Jockey Club “Giftedness Into Flourishing Talents” Project

Percentage – Discount

Mathematics Secondary 1

Level 1: School-based Whole-class Teaching



香港賽馬會慈善信託基金

The Hong Kong Jockey Club Charities Trust

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Background and Notes

The design of the learning and teaching plan reflects the actual circumstances of the particular school at the time of implementation. As it is developed and tailor-made to meet the specific cognitive and affective needs of students, all learning and teaching resources are for reference only.

When adapting the materials, curriculum, instructional and assessment modifications can be made in accordance with the diverse needs and abilities, learning styles and aspirations of students, professional competence of teachers, and gifted education development of the schools.

Teachers are strongly recommended to read the introduction, theoretical background and summary of the resource package to have a better understanding of the principles of Gifted Education and strategies for implementation.

This unit includes 1 foreword, 1 lesson plan, 3 sets of worksheets and 1 set of suggested answers.




With reference to our resources, educators can design suitable learning activities and implement the elements of Gifted Education, based on students' needs and interests, and teaching experience, so as to unfold students' potentials to the fullest.

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Percentage - Discount

Grade: Secondary 1

No. of Lessons (Learning Time): 2 Consecutive Lessons (60 minutes)

Prior Knowledge	Basic operations of percentages and percentage changes
Learning Objectives	<ul style="list-style-type: none"> - Students can acquire Mathematical language in conveying information, including the understanding of keywords 'marked price', 'selling price', 'discount' and 'discount percentage', and interpreting different ways of presentation about discount in daily life - Students develop Mathematical reasoning skills, including the comparison of discount percentage in different cases with suitable calculations, and exploring the change in the discount percentage when the prices and quantity change - Students develop collaboration skills through collaborating with others
Intended Learning Outcomes	<ul style="list-style-type: none"> - Students can present correct solutions to most questions in worksheets - Students demonstrate creativity by giving different answers in worksheets - Students understand and correctly use the keywords about discounts throughout the lesson - Students participate actively in group discussions - Students feel challenged when seeing the non-routine problems and persist in solving them
Learning & Teaching Strategies	Mixed-ability Grouping
Operation Mode of Gifted Education	Level 1: School-based Whole-class Teaching
Core Elements of Gifted Education	<ul style="list-style-type: none">  Higher-order Thinking Skills  Creativity  Personal-social Competence

Foreword / Background

'Percentage - Discount' is a topic already covered in the primary school curriculum. However, how well students can understand this topic covers a wide range. Some students might master the concept of percentage thoroughly while some may only know how to apply the formula to solve a simple problem without really understanding the Mathematics behind it. The project school uses English as the medium of teaching for Mathematics. Most students had not previously learnt the English vocabulary and phrases related to discount and discount percentage, so, usually, teachers needed to spend time introducing these English words and phrases. Routine textbook examples and practice exercises were then given to familiarize students with problems presented in English. For students who had already mastered the related Mathematical knowledge in primary school, they might not find it interesting and challenging enough to simply learn the same things in a different language.

The project school encourages collaborative learning in the classroom. In S1, students were seated in mixed-ability groups of 4 students in most lessons. Each group involved one high ability learner while the rest had medium or lower ability. Also, each group had a mini-blackboard so they could write down results of group discussion and show it to the class easily. Routines based on group work and the use of mini-blackboards were well-developed in the target classes. During discussion with Project GIFT, the teacher reflected that students were active in discussions and in answering teacher's questions. They were also keen on spotting others' mistakes and correcting them.

Objectives of Collaboration

One key concern of the math lesson is that all students are expected to become familiar with the English words and phrases related to discount. Moreover, all students are expected to develop a deeper understanding of percentage rather than simply knowing how to apply the formula without understanding it. Teachers and the Project GIFT team agreed that discount percentage is a topic that is closely related to students' daily life, hence, teachers would like to relate this topic more to students' everyday experience. With such a design, students could be more engaged in the learning activities. Furthermore, tasks that help nurture higher-order thinking skills and creativity could be designed to stretch the potential of the students, especially the high-ability learners. To utilize the well-established classroom routines and students' learning habits mentioned in the foreword, the teacher requested to retain the usual practice of collaborative learning and the use of mini-blackboards when designing the lesson and wanted to provide a chance for students to evaluate classmates' solutions. In such a collaborative classroom, students are expected to develop their personal-social competence. Therefore, the objectives of the collaboration between the Project GIFT team and the school was to design a lesson not only to help all students learn the terms and phrases about discount percentage in English, but also to promote in-depth exploration about discount percentage in a collaborative classroom.

Theoretical Framework

To promote in-depth exploration and understanding, higher-order thinking should be the essential element for designing this lesson. According to the Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001), higher-order thinking refers to the cognitive processes 'apply', 'analyze', 'evaluate' and 'create'.

When designing the lesson, learning activities that aim to help students remember and understand the basic concepts were compacted into a short beginning part of the lesson. Much learning time was dedicated to learning tasks that encourage students to apply knowledge to solve more complicated problems and to analyze the consequences when some values are changed in the calculation. In these learning tasks, students were also given the chance to evaluate the solutions of their classmates. Last but not least, students were asked to create different ways to express discount. With more focus placed on cognitive processes related to higher-order thinking, students were expected to develop deeper understanding and refine their thinking skills.

Tinzmann et al. (1990) observed that knowledge and authority are shared among teachers and students in a collaborative learning environment. To establish collaborative learning, teachers encourage students to bring their knowledge and strategies to the learning situation. They help students listen to diverse opinions, support knowledge claims with evidence, engage in critical and creative thinking, and participate in open and meaningful dialogue. Also, teachers adjust the level of support so students take responsibility for learning.

Collaborative learning is more than having students seated and working in groups. The lesson should be student-centred and the teacher should act mainly as a facilitator of learning not as a deliverer of knowledge. Students should be given the chance to solve problems without clear direction given by teachers. They should also be given time to discuss among themselves in groups before asking for teacher's support. Moreover, it is also important for students to look at one another's ideas and strategies on the problem so they can learn from their classmates.

Learning and Teaching Strategies

Pre-assessment by means of a worksheet was done before the lesson to check whether students had managed to handle the basic problems. If students had good mastery of basic knowledge, teachers could then focus on any common misunderstandings of students rather than re-teach contents students had already mastered.

To relate the lesson to students' everyday experience, students were asked to collect newspaper articles on or take photos of discount. Teachers explained concepts and keywords about discount percentage based on students' collections rather than just on textbook passages. Teachers also used some photos in the fund-raising activity at the school to draw students' attention. In daily life, students might see discount offered in ways that are more complicated than the textbook problems. More complicated problems about discount percentage were set to better relate subject contents

to daily life. Moreover, some questions that required students to consider change of quantity were added (Lesson Worksheet 1 Task 2). These questions require higher-order thinking skills. A divergent question (Lesson Worksheet 2) was set to help nurture students' creativity and at the same time check students' understanding. These tasks and questions were expected to help the whole class study the topic from different angles and hence provide more room for exploration and discussion among students.

To retain the usual practice of collaborative learning in the school, heterogeneous grouping was used as described in the foreword. In the lesson, students solved problems together and learnt from one another in a group setting. Mini-blackboards were used after each group task to allow students to present their ideas in words and symbols. If time allowed, some students were also chosen to present verbally to the whole class. In the lesson, most results were built and concluded by the students. Hence, they were expected to have gained a deep understanding of the topics.

Discussion

Lesson trials were done in two classes. According to observation by the Project GIFT team and school teachers, students participated actively in discussion in all of the learning tasks. In some groups, students wrote down wrong answers in the beginning but finally corrected them after some group discussion. It showed that the level of difficulty was suitably set for the target classes so students really thought deeply. Teachers who joined the lesson observation thought that students learnt more than they did in ordinary Mathematics lessons in this newly designed lesson. Teachers who conducted the lesson were surprised that some weaker students could complete Task 1 and even got the answer in Task 2. However, there was not enough time for the creative exercise in both classes. One class only had 5 minutes for this part and another class could only leave this part as a post-lesson exercise.

In the lesson, heterogeneous grouping was chosen as this was the usual practice of the project school. When conducting this lesson in other schools, students may not have the same grouping routine. Hence, teachers should decide what kinds of groupings are suitable based on students and school background and needs. For example, if teachers want the higher-ability students to move faster and learn extensively and want to provide more support to the weaker students, teacher may use ability groupings instead. In that case, teacher should adjust the level of difficulty to cater for different ability groups. For example, extra hint cards can be prepared for weaker groups while some guiding elements like the table in Task 1 can be removed for groups with higher ability.

During the post-lesson observation, some teachers and Project team members also expressed concern about those students demonstrating high Mathematical ability. Even though the lesson included mainly tasks requiring higher-order thinking skills, these students might work faster than the others and might need further challenges. Hence, an extra question was later designed (already added into the Powerpoint and worksheet). This question asked students whether the discount percentage can be found without a given marked price. The question helps extend

students' knowledge from numerical calculation to algebraic manipulation and is suitable for students who move faster in the lesson.

In the lesson, students worked mainly in group settings. Teachers had worries about whether all the students could work out the problem independently. Therefore, independent tasks could be given after the lesson so as to make sure all students could follow. Also, it is important for students to formally write down their working steps when learning Mathematics.

To conclude, one key reason for the success of this lesson design is that the level of difficulty was well set – complicated enough to promote higher-order thinking while still within students' ability level. When the level of difficulty is suitably set, students' learning can be maximized. Therefore, it is important for teachers to understand what students can master and what really urges them to think deeply when designing a lesson.