

CATEGORY 4 - RESOURCE DEVELOPMENT

UNDERSTANDING LOWER SECONDARY MATHEMATICS

Group 4-20

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ABSTRACT

This project is a resource created for the purpose of heightening the interest of Lower Secondary students in the Subject of Mathematics, thereby becoming an effective supplementary resource for students and teachers alike. It is a variation of a Snakes and Ladders board game with different coloured tiles that require the students to answer math questions based on the colour they land on.

1.0 - INTRODUCTION

1.1 - Rationale

Students transiting from Primary School to Secondary One tend to experience a huge increase in difficulty with Mathematics due to the change in the syllabus and may have trouble revising for their examinations. Secondary Two students may also have some trouble with their Mathematics due to the increased difficulty in the syllabus compared to Secondary One. As a result, students may develop a lack of interest in the subject. Based on our needs analysis conducted with students, 74.4% of respondents feel that learning Mathematics through games is appealing.

1.2 - Objective

This project aims to:

- Heighten the interest of Secondary One and Two students in Mathematics;
- Improve their mathematical skills;
- Allow students to learn Mathematics together and help one another improve; and
- Provide teachers with an engaging teaching resource for their Mathematics lessons.

1.3 - Target Audience

Our target audience are:

- Lower Secondary Students, and
- Teachers of Lower Secondary Students.

1.4 - Proposed Resource

The proposed resource is a board game called “Understanding Lower Secondary Mathematics”. It is a twist to the classic board game of Snakes and Ladders, infused with some Monopoly game concepts, and innovative gameplays developed by the project team, such as the “Supreme Dice Duet” and the “Calculator Mechanic”.

2.0 - REVIEW

There is much research on the benefits of games in helping to strengthen students’ mathematical skills. Besides being fun and motivating, the following are the benefits:

- Playing mathematical games encourages students to employ different strategies and concepts to solve mathematical problems. When played repeatedly, students develop computational fluency and strategic mathematical thinking while deepening their understanding of Mathematics.
- Mathematical games also present opportunities for students to practice their mathematical skills on their own. This frees up teachers’ time and allows them to observe and assess students, and work with them in smaller groups for more targeted attention where needed. Learning Mathematics through games also helps students to develop skills such as analytical thinking, problem solving and decision-making skills, all of which are important to mastering Mathematics. Thus, including Mathematical games in Mathematical teaching helps achieve a full range of Mathematical objectives.
- Mathematical games can also be played with parents; besides the bonding time with their child, the parents can revise the Mathematics concepts with their child by playing educational games together.

- Mathematical games that encourage discussions between players and with teachers help in the learning and revision of Mathematics.

3.0 - METHODOLOGY

3.1 - Needs Analysis

A survey was conducted with the objectives of finding out students' interest in Mathematics, the level of difficulty they have with the subject and the viability of the proposed project. There were a total of 43 respondents who participated in our survey.

3.2 - Survey Results

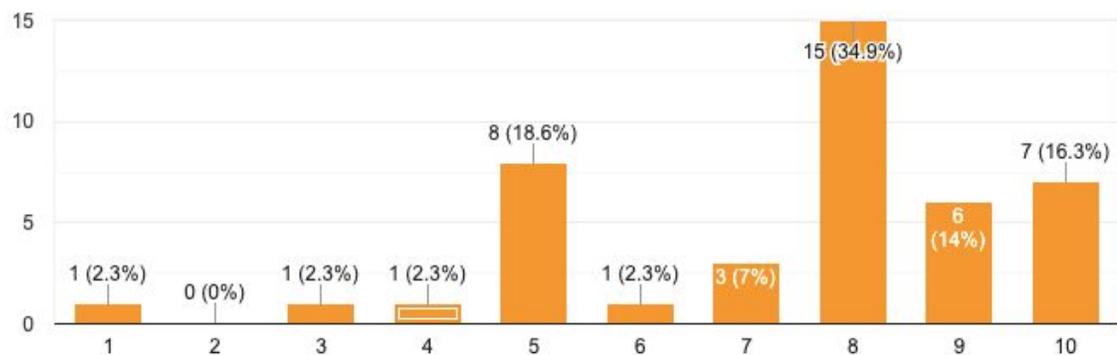
Out of the 43 respondents:

- 74.4% rated their interest in Mathematics to be a 6 and above (out of 10);
- However, 53.5% find it boring to revise Mathematics through notes;
- 53.4% rated the difficulty level of the subject to be a 6 and above (out of 10); and
- 74.4% feel that learning Mathematics through board games is appealing.

The survey results are shown in the graphs below.

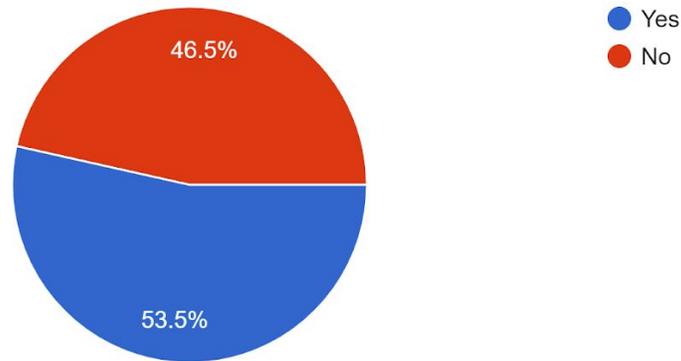
On a scale of 1 to 10, how would you rate your interest in Mathematics?

43 responses



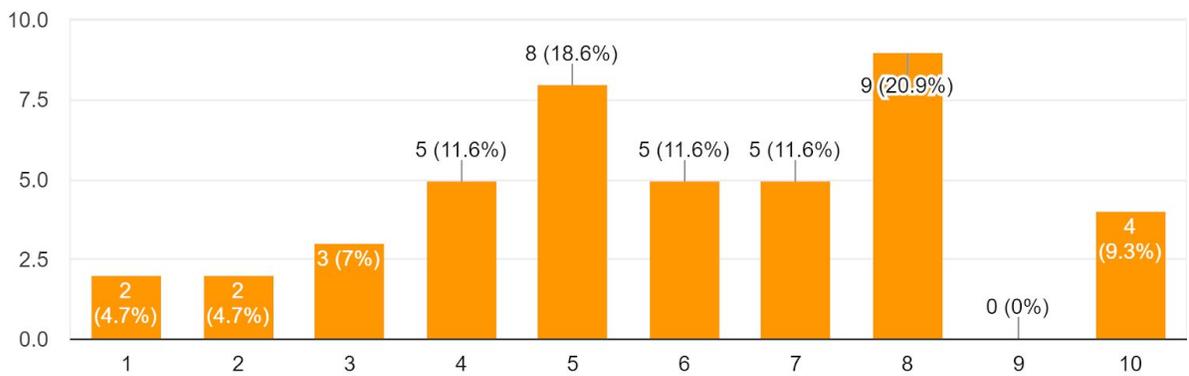
Do you think that revising notes for Math is boring?

43 responses



In your opinion, on a scale of 1 to 10, how would you rate the difficulty of Mathematics as a subject?

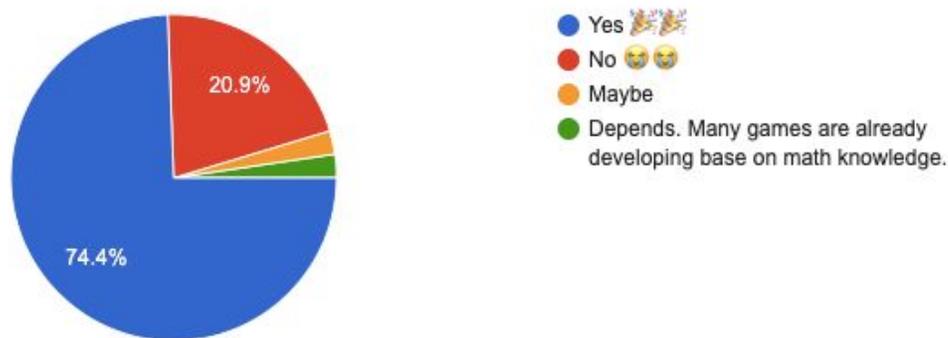
43 responses



Do you think that learning Mathematics through card/board games will be appealing?



43 responses

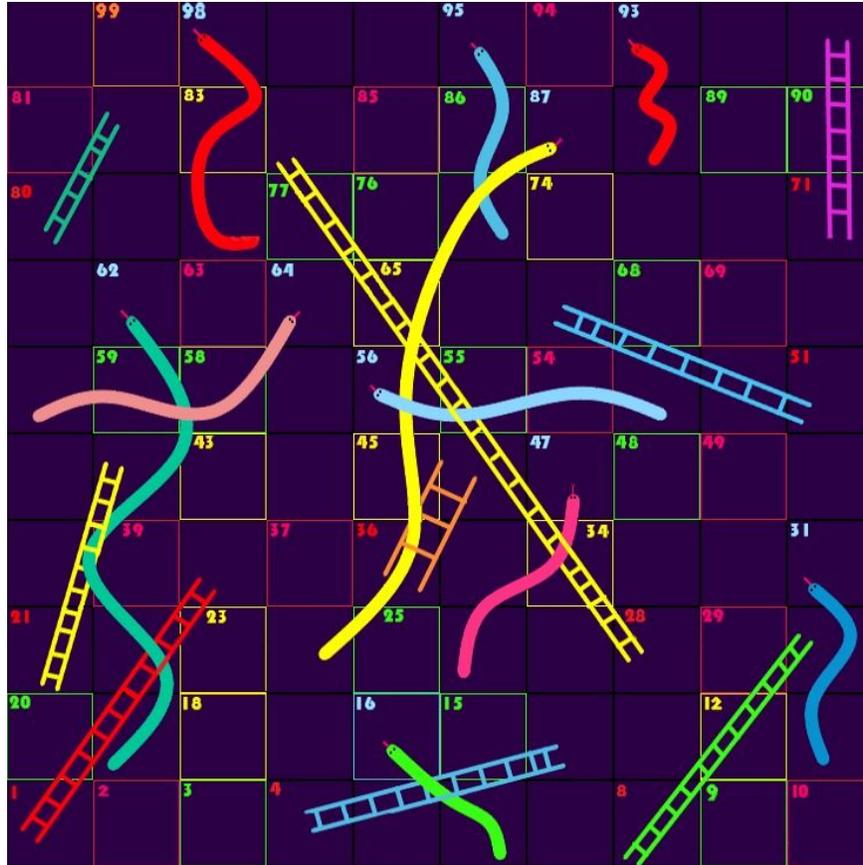


3.3 - Development of the Resource

Our resource is based on the classic board game of Snakes and Ladders - we adopted the game board to allow players to have fun learning and revising Mathematics, through the excitement of progressing when they answer questions correctly, or the disappointment of sliding to the end of a snake's tail when they answer a question incorrectly.

The game also includes some concepts from the board game Monopoly - question cards are drawn if you land on a game board tile with a coloured border, similar to how you draw a card if you land on a Chance or Community Chest square in Monopoly.

Additional game modes are available to add excitement and facilitate learning.



Sample board shown above

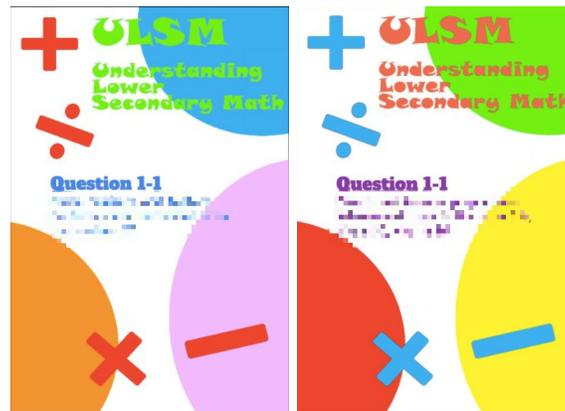
The questions covered in the game incorporate the mathematics topics listed in the New Syllabus Mathematics 7th Edition ShingLee textbooks for Secondary One and Two, which covers the full curriculum for lower secondary students in Singapore. They have been endorsed by two Secondary school Mathematics teachers, who are our project mentor and our group leader's aunt.

3.4 - Rules

3.4.1 - Basic Rules

- Be the first to reach the 100th tile on the board to win.
- The game ends when everyone reaches the 100th tile.
- On your turn, roll a six-sided dice to decide which tile you are going to next.

- Move to your next spot within 5 seconds by doing a simple addition equation (e.g. Initially on tile 1 + Roll 5 on dice = Land on tile 6), or you cannot advance. This is optional.
- If you land on a tile with a coloured border, you have to draw a card and answer the question on it.
 - Level 1 (easiest) question tiles have a yellow border;
 - Level 2 question tiles have a green border;
 - Level 3 question tiles have a pink border;
 - Level 4 (hardest) question tiles have an orange border; and
 - Snake questions have a blue tile number and Ladder questions have a red tile number.



Sample question cards shown above

- If you roll a 6 and land on a tile with a coloured border, you do not have to answer that question.
- When answering questions, players are allowed to consult one another for help if they are unable to answer a question. Players are also allowed to use a calculator.
- The table below shows the rewards for the different types of question cards answered.

Question cards and rewards			
Type of question	Reward (ONLY if answer is correct)	Time limit (optional)	
Level 1	Advance 1 step	30s	
Level 2	Advance 2 steps	60s	
Level 3	Advance 3 steps	90s	
Level 4	Advance 4 steps	150s/180s	
Snake/Ladder	Ladder: Go to top of ladder	Snake: Stay put	60s

3.4.2 - Additional Game Modes

Two additional game modes are available to add excitement to the game and facilitate learning.

Additional Game Mode 1, "Supreme Dice Duet"

Upon answering a level 3 or 4 question correctly, an additional dice roll using 2 dice is initiated. Another player must tell the player who rolled the dice an equation using the 2 numbers combined with any operatives (+, -, ×, ÷, ^) and the player must solve it within 5 seconds.

For example:

- Player 1 rolls a 3 and a 4.
- Player 2 can ask, "What is 4^3 ?". If Player 1 answers correctly, he gets to make any player move back according to either one of the numbers he rolled. Because he rolled a 3 and 4, he can choose to make anyone else go back either 3 or 4 steps.

Additional Game Mode 2, “Calculator Mechanic”

The “Calculator Mechanic” allows players to ask the game facilitator for clues to answering a question. The “Calculator Mechanic” can be determined by rolling a 12-sided dice.

<u>Question Level</u>	<u>How to Get a Clue</u>
1	Roll a 1 on the 12-sided dice
2	Roll a 1 or 2 on the 12-sided dice
3	Roll a 1, 2 or 3 on the 12-sided dice
4	Roll a 1, 2, 3 or 4 on the 12-sided dice

3.5 - Pilot Testing

A total of 14 participants took part in our pilot test. These comprise of 7 Secondary 2 students, 5 Secondary 1 students, 1 Mathematics teacher and 1 parent.

In general, the participants gave encouraging feedback, with the majority of them approving the game’s overall smoothness, its fun factor and its helpfulness towards students’ Mathematics skills.

There were suggestions for the some of the questions to be made easier. We noted the feedback and ensured that the number of questions were well-distributed across the four levels of difficulty. Some level of difficulty was maintained to ensure sufficient questions were available to hone the players’ grasp of mathematical concepts.

There were also some feedback that the waiting time was too long for each player’s turn. Thus, we reinstated an optional rule for a time limit to answer questions, and have also allowed players to consult one another if they needed help. The latter encourages

a supportive environment for students to learn Mathematics together and help one another improve.

In summary:

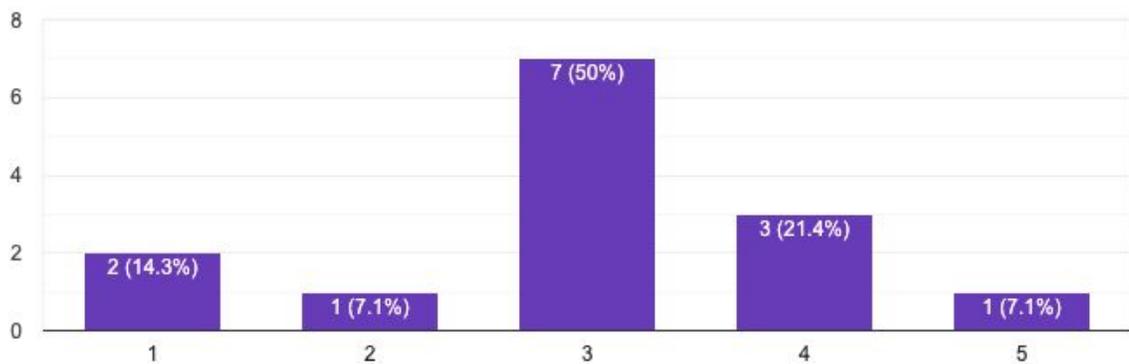
- 78.6% of respondents rated the smoothness of the game to be 3 or more, over 5.
- 78.6% of respondents rated the fun level of the game to be 3 or more, over 5.
- 85.7% of respondents rated the game to be helpful towards their math skills.
- 85.7% of respondents enjoyed the overall process of the game.

The responses from the pilot testers are shown in the graphs below.

Rate the smoothness of the game you just played. (like is the game process fluent or not)



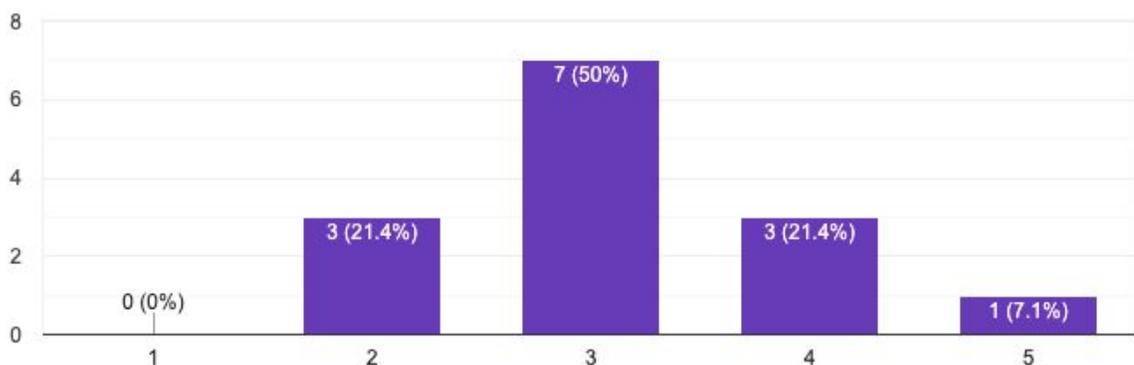
14 responses



Is the game fun? 😍

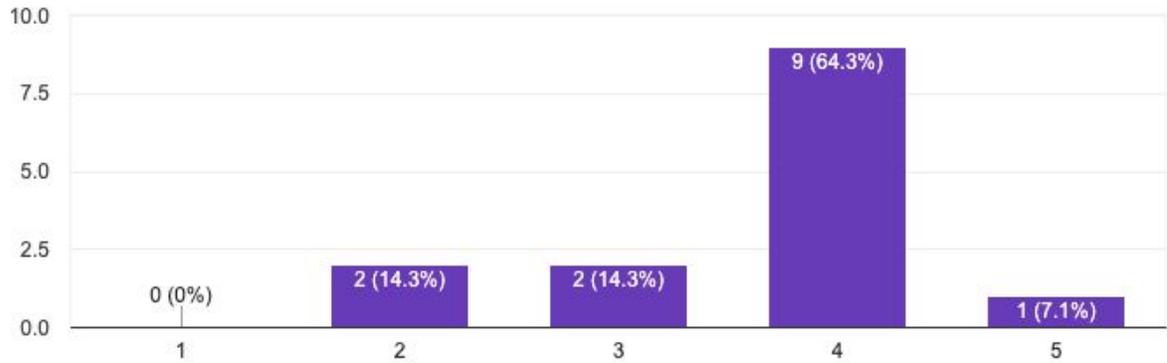


14 responses



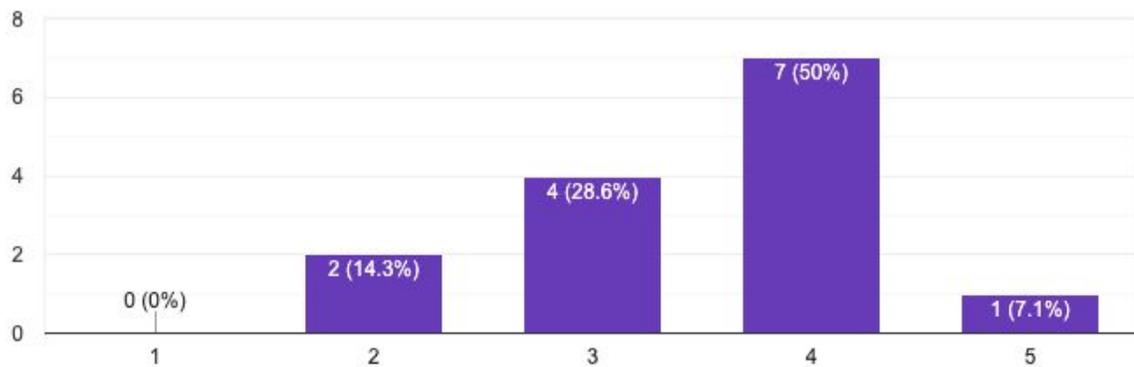
How helpful do you find this game towards your Math skills in general? 📄

14 responses



Did you enjoy the overall process of the game? 📄

14 responses



4.0 - OUTCOME AND DISCUSSION

In response to feedback from the pilot test participants, we had refined the gameplay to ensure the project objectives are met. We also took the advice of the panel of judges to include research evidence on the benefits of games to strengthen students' mathematical skills, and to ensure the game questions were endorsed by teachers.

Based on the positive and encouraging pilot test results, the final outcome is a resource that can be used by both students and teachers alike to support the learning and revision of Mathematics for Lower Secondary students.

Further ideas to extend and improve the game beyond this project include building an online version that allows students to play and learn together from the comfort of each one of their own homes. Another enhancement is to allow teachers the option of including their own set questions to be printed on a card template, thereby keeping the game questions fresh.



5.0 - CONCLUSION

We embarked on this project to develop a resource to help Lower Secondary students improve on their Mathematics. Through the process, we encountered a number of challenges, e.g. with differing opinions on gameplay designs, setting up our game components for printing at a reasonable price, compiling the list of many game questions of varying difficulty levels, and juggling time spent on the project with our other regular school tests and assignments. While these were at times difficult and frustrating, we have learnt invaluable lessons on working together as a team to achieve our project objectives. We have also honed our planning and problem solving skills. Lastly, as a group, we have grown closer in our friendship and matured in the process.

6.0 - REFERENCES

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