GRADE 10 SOCIAL STUDIES: Codemakers & Codebreakers

Summary of Learning Opportunity

Prior to this lesson, students learned foundational content knowledge about World War II, including the importance of the Battle of the Atlantic and Germany's use of the Enigma coding machine to coordinate U-boat attacks on Allied ships. In this lesson, students investigated the impact that ciphers and code breaking had on WWII. We first read the article "How Mathematics Helped Win WWII" and had small group discussions about different ciphers and the importance of codes throughout history. Students experienced and learned code-breaking functions firsthand by solving different variations of the Caesar cipher to create a code phrase. We came back together as a class to discuss the challenges faced by code breakers and evaluate the significance and impact of code breaking on the modern world. To close the lesson, students wrote individual responses to the guiding questions: How significant was code making and code breaking to WWII? What impact did mathematics have on WWII?

Social Studies Grade 10	**Learning Standards**	• Use Social Studies inquiry processes and skills to ask questions; gather, interpret and analyze ideas and data; and communicate findings and decisions
		  ○ Draw conclusions about a problem, an issue or a topic.
		  ○ Interpret and present data in a variety of forms (e.g., oral, written and graphic).
		• Assess the significance of people, places, events or developments, and compare varying perspectives on their significance at particular times and places, and from group to group (significance)
		• International conflicts and co-operation

Literacy/Numeracy Connections	Instruction and Assessment	Competencies Developed, Practiced and/or Assessed
NUMERACY: Interprets – Understands the real-world problem	1. Students constructed a shared understanding of ciphers and codebreaking, and their significance in WWII. Activities included: learning foundational content knowledge through direct instruction, reading a short article ("How Mathematics Helped Win WWII") and small group discussions to summarize knowledge.	Use Social Studies inquiry processes and skills to ask questions; gather, interpret and analyze ideas and data; and communicate findings and decisions
NUMERACY: Solves – Solves the mathematical problem	2. Students had hands-on experience in using and creating ciphers and in code breaking. Students were randomly assigned into groups (Britain and Canada), each with their own code phrases to solve using ciphers. Groups are given 20 minutes to collaboratively break each set of codes by using a Caesar cipher. The first group to break their code and complete the action embedded in the code had the honour of ending the war.	Use Social Studies inquiry processes and skills to ask questions; gather, interpret and analyze ideas and data; and communicate findings and decisions Core Competency (Communication) – Working Collaboratively

LITERACY: Communicates – Expresses Ideas and Information

3. Following the activity, a whole class plenary was held where students discussed the code-breaking process. They discussed the levels of difficulty of the different codes and reasoning for this judgement.

Students completed a written response to the article, the activity and the guiding questions: How significant was code making and codebreaking to WWII? What impact did mathematics have on WWII?

Assess the significance of people, places, events or developments, and compare varying perspectives on their significance at particular times and places, and from group to group (significance)

Core Competency (Thinking) – Analyzing and critiquing

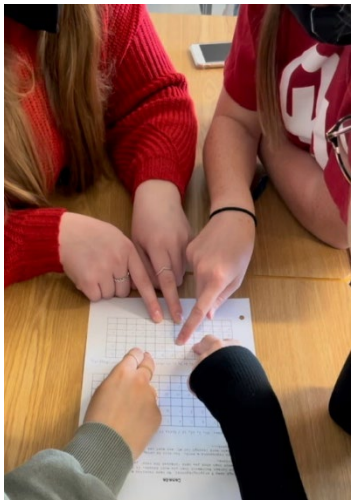
Demonstrations of Student Learning, Teacher Assessment, and Reflection

GROUP 1: Britain

Greetings Bletchley Park cryptographers! We have received a coded message from the German Wehrmacht that you must decode. It is of the utmost importance that once you have 'cracked the code' you follow the instructions.
Each code represents a word. You will be using the Caesar cypher to decode each word (except for #5) and must use the hints. Good luck and Godspeed...

1st Word
Code to Break: 19,1,25 / Hint: It is what it is.

1	2	3	4	5	6	7	8	9	10	11	12
A	B	C	D	E	F	G	H	I	J	K	L
14	15	16	17	18	19	20	21	22	23	24	25
N	O	P	Q	R	S	T	U	V	W	X	Y



Partial Transcript of Student Conversation:

Student A: So there's a T-E-A…. what would that be a C?

Student B (sounding out): Teak? That's not a word?

Student C: What's next then? T-E-A-I…no.

Student D: Teach?

Student A: Oh yes!

Student C: Ok….so T-E-A-C-H… is that an F?

Student A: No – we have to shift the letter again

Student C: Oh yah

Student B: Then it's an E…. wait could that be teacher?

Student C: Count it back….

Student B: It is teacher! I guess we were right

Teacher's Observations and Assessment

This group of four students were successful in solving all of the ciphers and reporting the "code phrase" to the teacher. While they struggled in the initial solving, once they figured out the key they were able to critically apply it again to solve the remaining clues.

In their feedback during the class plenary, the students discussed how difficult code breaking must have been as one student described "especially if the codes kept changing every 24 hours! That's, like, impossible!" They were able to interpret the situation, solve the code, articulate an understanding of how difficult the task must have been; this garnered an appreciation for how mathematics were instrumental in ending the war.

The students worked collaboratively to solve the mathematical problem. Throughout this exchange, students were able to understand the problem and used logical thinking to solve it using counting strategies. What I found really interesting was how the group used different problem-solving strategies (Student A tracked the letters, Student B wrote down the letters so they could be visually spotted by the team, Student C and D finger tracked alongside.)

Teacher Observations and Assessment

These responses clearly demonstrated that students met the Literacy skill of Expresses Ideas & Information. The student explained their ideas and understandings clearly, using their understanding from the prior learning, the article and their experience solving the puzzles to synthesize a response that showcased the significance that code making and breaking had on WWII. I particularly liked that Student D highlighted that it was math "and perseverance" that helped the Allies win the war. This demonstrated a connection to the core competency of Thinking – this student was able to make connection to the habits of mind like grit for instance, that demonstrate what a critical and reflective thinker should be.

Reflective Response: *What impact did mathematics have on WWII?* Student C

Math played a very important role in the Allies winning WWII. Math helped the most when first figuring out how to crack the Enigma. There were so many different ways the messages could be coded and, since they changed often, it would not work to figure out the code. Instead, a Pole mathematician used the permutation theory which is used to determine the number of possible arrangements in a set when the order matters. Even though he failed multiple times, he figured it out. A win for math is what this was, and it solved the first problem in decoding the German messages.

Reflective Response: What impact did mathematics have on WWII? Student D

Mathematics played an important role in the battles of WWII. After the failure of WWI, Germany was determined to prevail in all aspects of the war, and that included code. They created a machine that was used for creating codes and messages; it was named the Enigma. The Enigma's ability to rotate letters and the use of rotors increased the theoretical number of possible configurations, and made codes that were seemingly impossible for the Allies to decipher. However, it was Marian Rejewski, a Polish mathematician, who made the initial mathematical breakthrough that lead to the critical first steps into winning the war. Later down the road, Alan Turing joined, and, as the leader of the code breakers in Britain, lead his team to invent the Bombe, a machine that could rapidly compare keys from the Germans. And in the end, math and perseverance helped the Allies read and decipher codes that enables many sneak attacks and bombings to be stopped, and thousand of lives to be saved.

Teacher Reflection

The ability for me to structure my planning, teaching and assessment around three core skills of the Literacy and Numeracy Learning Progressions (Interpreting a Problem, Solving a Problem, and Expressing Ideas and Information) that were symbiotic with the Social Studies Curricular Competencies meant that I could assess both the competencies and students' understanding of the historical thinking skills at the same time.

I wanted to provide a 'hands-on' lesson where students could attempt to understand the real-world pressures of coding in a digestible and 'low-stakes' way. I felt this might give them more of a personal connection to understanding significance. I was delighted that some of my students were able to draw out the grit and perseverance of codebreakers. It directly connected to the First Peoples Principles of Learning, "Learning involves patience and time", and to the Core Competencies. To me, this meant that the lesson made a connection with students personally that they could apply to their own lives.

I also valued listening to the 'conversation' as students collaboratively worked to solve puzzles to help support my assessment of their work. In terms of skills related to the curricular competencies this was invaluable. The ability to work as a team, self-correct, support and solve are instrumental skills in learning. The first listed Curricular Competency in Social Studies 10 is "*Use Social Studies inquiry processes and skills to ask questions; gather, interpret, and analyze ideas and data; and communicate findings and decisions*". In their puzzle solving group, students were very engaged in all of these competencies. These skills should happen naturally when students are learning.