

Cross Curricular Use of Technology for Solving Mathematical Problems: Exploring Angel Falls Interdisciplinary Plan

Ceren Zobi¹

¹Ted Ronesans College

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Abstract

This short practitioner report presents information for the planning, teaching and evaluation cycle of a cross curricular Computing, Geography and Mathematics lessons in a 5th grade classroom. The study focused on both mathematical thinking and Geographical knowledge. The objective of the lesson was to teach children measurement and prediction skills through exploring the Angel Falls, located inside of the Canaima National Park in Venezuela, using the Google expedition application. For the purpose of this study, action research was chosen whereby the findings of this study were used to inform future planning and improve learning. The study found that the students were able to use their logical reasoning to predict the length of many objects including the Angel Falls. The project also found that providing children with real-life learning contexts motivated them to learn and made learning more meaningful. The children were able to transfer and apply their prediction skills during their coding sessions, which highlights the link between mathematical and computational thinking.

Keywords: Real-life experiences, logical reasoning, computational thinking, mathematical thinking, predictions, cross-curricular learning, integrated learning

1. Introduction

In this short practitioner report I will be discussing how I planned and taught a series of lessons to provide learning experiences for students in a real-life context using technology as a tool. The students were taught about the Angel Falls found in the Canaima National Park, Venezuela, using Google Expeditions application. Within the lesson I focused on providing students with a real-life problem whereby they can develop and apply their mathematical, technological and geographical knowledge and understanding. The main reason for this is that teaching mathematics through experiences and contexts that students are interested in can make learning more meaningful and relevant to students (Turner & Strawhun, 2007). It also been suggested that the knowledge and experiences that students bring from their everyday lives can serve as resources for the teaching and learning of mathematics (Civil 2002, 2007). Furthermore, there is evident that when concepts and skills are connected to real life contexts and situations, student learning is enhanced (Boaler, 2008).

From the aspect of computational concepts, during this project, the students had to use their logical reasoning to make predictions for solving problems which can be seen as part of computational thinking (CAS Barefoot Computing, 2014; Voogt et al., 2015). Making predictions is an important aspect of computational thinking as children constantly use their prediction skills to predict the behaviour of simple programs that they have written. In this scenario, prediction helps the students to plan and evaluate their solutions. This skill is used by children in many subjects, for example in this study the children had to use their logical reasoning to make predictions about the height of the Angel Falls. This also highlights the close link between mathematical thinking and computational thinking (Wing, 2016, 2011).

2. Literature review

A number of studies have suggested that integrating traditional learning materials with technology tools can be beneficial for learners (Gray, 1991; Wirt, 1991). One reason for this might be that technology has the power to provide learners with real-life situations from outside of the classroom. This was also supported by The National

Council of Teachers of Mathematics (NCTM) who stated in their standards that students should be able to confidently use their mathematics skills to explain applications in the outside world and to analyze situations that arise in the real world (NCTM, 2014).

The review of the literature also suggest that technology can enhance students' understanding of mathematical concepts (Clements & Battista, 1994; Graham & Thomas, 2000) and improve their achievement (Hembree & Dessart, 1992; Kaput, 1992; Quesada & Maxwell, 1994). Furthermore, the implementation of technology for learning in other curricular subjects can improve classroom experiences for students (Guerrero, Walker, & Dugdale, 2004).

In addition to this a cross-curricular teaching and learning approach provides students with active and experiential learning experiences. When cross-curricular learning happens, it can positively impact on the learning process in two ways; "First, young people are encouraged to integrate learning experiences into their schemes of meaning so as to broaden and deepen their understanding of themselves and their world. Second, they are engaged in seeking, acquiring, and using knowledge in an organic – not an artificial – way" (Beane, 1995, p.616). My aim was to provide my students with an organic learning experience that would engage them to deepen their thinking and understanding of measurement and prediction skills.

3. Methodology and Procedure

An action research approach was adopted, whereby observations were used to study the student's attitudes to learning in a technology supported learning environment. The reason for selecting this method was because my aim was to improve my practice through reflections (Elliott, 1991). My research started with a practical question from everyday educational work (Altrichter et al., 2005): Can a cross-curricular use of technology for teaching problem solving in mathematics improve students' attitudes to learning? The study took place in an independent primary school in Istanbul and included 75 students in total.

The lessons were taught in a combined approach during social studies and mathematics sessions. Firstly, the social studies teacher introduced and modelled the use of the Google Earth Program by explaining how to locate Venezuela. Then the students were asked to explore the other continents, countries and characteristics of the land. They were then asked to complete an online research questionnaire about the Angel Falls and Canaima National Park. They were then asked specific questions about the Canaima National Park and to use different websites to answer them.

During their mathematics sessions the students were told that they would be predicting and measuring the height of the Angel Falls. They knew that the Angel Falls are the world's highest uninterrupted waterfall, however, they had not investigated its height yet. The students were asked questions about measuring length in-link to including real life context. I think that this made the students more excited about the topic and motivated them with their learning.

The main questions that were asked:

- How can sailors measure latitude and longitude whilst at sea?
- How can scientists measure the magnitude of a tsunami?
- Which materials can we use for measuring length?
- Do you remember the basic unit for measuring length?
- Share the ways / methods that you know for measuring the length of any object?

The last question was, 'Which common word did you hear in all these questions?'. Through peer and class discussions the students were able to recall their prior knowledge in measuring length and making predictions. I modelled the use of a metre ruler and then discussed how we could use this to measure the length of the Angel Falls. They visualized the Angel Falls and then made predictions to estimate its height. This involves both mathematical and computational thinking.

During the teaching sessions the children's learning was scaffolded through open-ended questions that aim to deepen their thinking. Some of these were:

- Can you give an example of our natural resources in Turkey?
- How many waterfalls are there in our country? Do you know which is the highest one?
- Where is the World's highest waterfall? Can you estimate the height of that waterfall?

After these questions, the students started to use cardboards to explore the Angel Falls by using the Google expedition application. At the same time, I provided them with information about some geographical features of the Angel Falls that involve numerical data such as tepui's height on the fall, which can reach 2,500 metres. At the end of this session the students applied their knowledge and understanding to solve word problems about measuring length.

4. Findings and discussion

This short classroom investigation study found that prior knowledge plays an important role in children's construction of new knowledge, making learning meaningful. This also shows that teachers should be aware of children's prior knowledge, in order to plan and teach according to their needs.

It was very clear from the observational data that the children were able to recall not just what they had learned in this session but from other mathematics and also in other subject lessons such as geography, art and physical education. This shows that they were able to retain their knowledge and understanding of measuring skills.

Another interesting finding of this study was that the students were able to solve paper-based problems which were again based in a real-world context. This was also supported by Boaler (1998), who noted that the students who learn through meaningful real-world experiences are able to apply their mathematical knowledge and skills to different learning contexts (Boaler, 1998).

The project also found that the children's attitude to mathematics learning in this cross curricular context was more positive than their general mathematics sessions. They were engaged and always stayed on task. They asked many questions and were very interested in finding out about this place and its characteristics. I think that because this was a real location, it made learning about it more interesting for them.

In terms of measuring skills, at the beginning the children found it very hard to estimate the height of the Angel Fall correctly. After this session, they were able to estimate the length of the many objects correctly. This shows that their understanding of length and making predictions using logical reasoning had improved. Another interesting finding was that they were able to use their prediction skills more accurately during other activities such as coding when making games using Scratch, which was again focusing on real life topics. This suggests that the students' use of prediction skills is facilitated through providing them with real life problems. This motion of providing students with learning experiences in a real life context was also supported by Businskas (2008), who argued that real world connections motivate learners and enable them to transfer their mathematics skills to solve problem in new contexts.

Exploring the Angel Falls with Cardboards and Google Expeditions program I was able to transform an abstract learning into a concrete experience which is very important when working with young children. The children were able to see the 360-degree photos of Angel Falls which was taken from different perspectives.

5. Conclusion

In conclusion, this study can suggest that integrating technology as a tool for learning into a classroom environment can increase the motivation of the students and change their attitudes towards the lesson. It makes the concept less complicated and abstract for children.

Through this cross-curricular & integrated approach, the children were able to connect the concepts that they had learned in different subjects and use this to construct their new knowledge. This experience provided the children with a space to develop crucial skills and they were then able to apply this to their learning in geography, history and computing. The link between mathematics and geography was also emphasised by Guido (2017) who argued that studying any topic related to geography requires the tools of mathematics.

During these integrated geography and mathematics sessions the children had many opportunities for developing and using their prediction skills. They were later able to apply this in another learning context, which is coding. They were able to predict the behaviour of their script and describe the action that a code would make happen. This shows that this integrated teaching approach helped learners to retain their knowledge and understanding and then use it to achieve a goal in different lesson context.

This was a small-scale study focused on one technology tool, further studies where more classes from different ages should be included and other technology tools should be used for teaching and learning to investigate the impact of cross curricular use of technology on children's learning.

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