Mathematics and Technology: Infinity through a WebQuest

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Abstract. *As technology becomes more available in classrooms, it is essential that teachers be secure with the use of that knowledge. As a Mathematics teacher this challenger increases. Knowing that some subjects are very complex, such as the notion of infinity, we've created a WebQuest to work out with the students, on this matter, at the classroom. A WebQuest is an organized learning activity available in the World Wide Web that applies to a variety of teaching situations and leads the students to a rich and powerful experience. It's supported by the new potentials of collective and interpersonal communication that Internet provides and allows cooperative work. Students must work in groups following a procedure of extracting information from various sources. This approach involves students in asking questions and making observations in order to find answers and learn scientific concepts with a hands-on experiment. The intention of this article is to propose a set of desirable attributes for such activities.*

Keywords. Hands-on experiments, Mathematics, WebQuest.

1. Introduction

Since ancient times, Art and Mathematics crossed each others ways and there always has been a concern to establish a perfect ideal. With the developing of technology, Mathematics becomes more challenging to the students. As a result of this, we've decided to make a WebQuest about the infinity to be applied, during a month, to students between 13 and 16 years old.

According to Martinho (1996, p. 42), *Art and Science walked together during many centuries, reckoning there is a common factor between both: creativity as an increasing motor of forms and ideas*[1] [11]. She adds that (p. 51) *the approach to an abstract universe through concreted constructions and entertainment activities seams to be, not only extra motivator, but also a efficiently media of formulating students conceptions and contributing to their reformulation*[2] [11].

We will try to suggest that thinking in terms of nondeterministic processes may be helpful in creating Mathematics and that the resulting Mathematics is the Mathematics of creativity.

Costa (2004) adds that *Science teaching at school should be generalised aiming not only the sound establishment of a "Science" culture in our societies but also to guarantee a steady basis for the improvement of Sciences and its technological applications. (…) Scientific and Technological literacy is also of great importance for citizenship and democratic participation in a world where Science and Technology issues and demands have a dominant role* [7].

Everyone needs to study to obtain a degree. Students spend most of their time in the school. So teachers have a crucial role in our society. They are models for our children. Most of the pupils will decide what to be in the future by interacting with those. They must seek an enlarged involvement of the community in order to get feedback from the pupils.

In this paper, we are going to explain what a WebQuest is, how is going to be applied and in what way students can learn more efficiently Mathematics using this kind of material, what is the advantage of analyzing Mathematics in this way, offering the possibility to add an experimental element to the study of logic.

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1 Original version: a Arte e a Ciência caminharam juntas durante muitos séculos, não sendo difícil reconhecer que comportam um factor comum essencial: a criatividade como motor gerador de formas e ideias.

2 Original version: a aproximação a um universo abstracto a partir de construções concretas e actividades lúdicas parece ser, não apenas mais motivadora, mas também um meio eficaz de problematizar as concepções dos alunos e contribuir para a sua reformulação.

2. Characterization of the school

The Escola Básica 2.3 de Freixo is placed in the north of Portugal, next to Ponte de Lima. Most part of the community lives from the agriculture. Mainly the pupils don't have many aspirations to continue studying. So the teachers need to be continuously motivating them to their matters. In the case of Mathematics, the lessons require for sure an extensive search for support material that may allow the students to execute their task without difficulty and more efficiently.

The school has 438 pupils, 201 girls and 237 boys, almost 50% of each gender. It's a public institution. It presents the educational community with a computers classroom where every group of pupils have at least one class for week. This way the WebQuest can be applied.

Figure 1. School symbol.

3. WebQuest: description

The originator of the WebQuest concept was Bernie Dodge (1995) at the activities of EDTEC 596, "Interdisciplinary Teaching with Technology", and according to him (1995), a WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the internet, optionally supplemented with videoconferencing [8]. This way, WebQuest give students a task that allows them to use their imagination and problem-solving skills. They can explore issues and find their own answers.

There are at least to levels of WebQuests according to the goals complexity. In this case we adopted a longer term because of the theme: infinity. We expect that this complexes matter through an amount of educational images among the technology extends and refines that knowledge.

A WebQuest should contain six building blocks: introduction, task, process, resources, evaluation and conclusion. It might be improved by wrapping motivational elements around the essential configuration by giving the learners a task to participate. A WebQuest is a group activity based in the Internet. According to Carvalho (2002, p. 148), a WebQuest is a step ahead in the utilization of the Web inside the classroom. It combines the teacher's work with the student's tasks, becoming an important intermediary between both [4].

To increase the motivation of the pupils we used some of Escher's images. The infinity was one of his predilections. According to him (2000), not one of us needs to doubt the existence of an unreal subjective space. But personally I am not sure of the existence of a real, objective space. All our senses reveal only a subjective world to us; all we can do is think and possibly mean therefore we can conclude the existence of an objective world [9].

Figure 2. Self-portrait. M. C. Escher (1943).

4. *Infinity*

From the time people began to think about the world they lived in, questions about infinity arose. Would the world go on for ever or was there a finite end? Above the earth one could see stars, planets, the sun and moon, but was this space finite or do it go on for ever? What happened if one cut a piece of wood into two pieces, then again cut one of the pieces into two and continued to do this. Could one do this for ever?

We know Mathematics that requires quantification over infinite sets is useful because it can make it easier to decide practical questions.

But is there really such a thing as infinity?

According to Spencer (1997), it's a tough question, because the word "infinity" can mean different things in different contexts. (…) in the context of a number system (…) "infinity" would mean something one can treat like a number, (…) in the context of a topological space (…) "infinity" would mean something that *certain sequences of numbers converge to.*

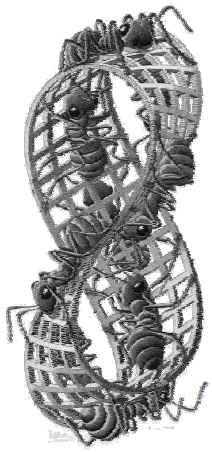

Figure 3. Moebius band II.
M. C. Escher (1963).

In the context of measuring sizes of sets (…) "infinity" means a measurement of the size of an infinite set. In this context, such "infinity" concepts do exist but there are more than one of them, since not all infinite sets have the same size. So there does not exist any one single "infinity" concept; instead, there exists a whole collection of things called "infinite cardinal numbers" [13].

Martinho (1996, p. 24) adds that the infinity can be classified as potential and as real (cardinal, ordinal and not-standard) [11].

Around 1956, Escher dedicates most of his work to infinity. We can organise it in three categories: cycles, tessellations and limits.

Martinho et al. (1998. p. 23) said that in the cycle concept it is implicit the knowledge of potential infinity. What better way that a cycle to represent finite a non-stop process![3] [12]

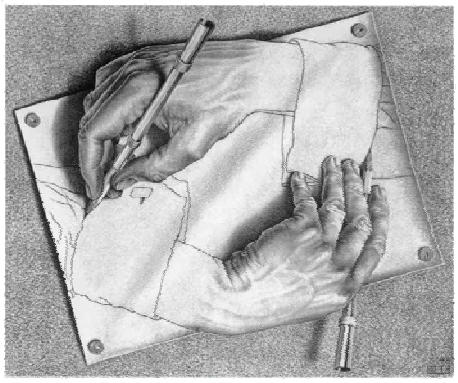

Figure 4. Drawing hands. M. C. Escher (1948).

According to Martinho et al. (1998), *the regularity of the tessellation process suggests an unlimited procedure (…) so that Escher made some three-dimensional representations in wood spheres*[4] [12].

Figure 5. Sphere with fishes.
M. C. Escher (1940).

According to Escher (2000), *to get a sense of what this space is like, imagine that you are actually in the picture itself. As you walk from the centre of the picture towards its edge, you will shrink just as the bats in the picture do, so that to actually reach the edge you have to walk a distance that, to you, seems infinite* [9].

[3] Original version: implícito no conceito de ciclo está a noção de infinito como um potencial. Que coisa melhor que um ciclo recorrente para representar finitamente um processo que não termina*!*

[4] Original version: *a regularidade do processo de pavimentação e o seu carácter sistemático, sugerem a possibilidade de prosseguimento ilimitado (…) Escher concretiza então representações tridimensionais em esferas de madeira ou marfim.*

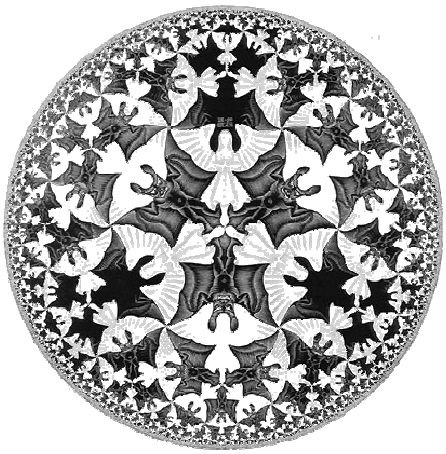

Figure 6. Circle limit IV. M. C. Escher (1960).

5. Goals

- According to Costa (2004), *we will collect and sum up continuously knowledge, information, materials, ideas, curricula and experiences from past and ongoing Socrates (Comenius and others projects in related fields)* [7]*;*
- According to Costa (2004), *describe good practices and transform these into better practices in Teaching and Learning Science* [7]*;*
- We expect that this WebQuest leads the students to a better comprehension of the Mathematics;
- Pupils should improve their Mathematics results;
- Teachers might be able to locate many difficulties that children have in their attempt to understand the infinity;
- Use the Internet as a powerful source of information.

6. Conclusion

A self-made knowledge will be achieved by the pupils that participate in the project. The product of their work will be exposed to the whole community at the Mathematics week. The students that will be absorbed with the acquisition of particular competencies about the infinity can build up a critical attitude and develop the taste for studying. They may also increase the predisposition to analyze problems with different approaches.

Notice that the effective use of hands-on experimental activities in the classroom can induce the students to learn how to learn. At this point they must observe and interact with the problems of our society, connecting with the school, in particular with Mathematics.

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