

# Climbing the stairs: implementing the IBL from students' explorations to teachers' motivation

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TOPIC 2, practice-based presentation

## 1. Introduction

The experience of implementing the Inquiry based learning in a Bulgarian mathematical high school is considered through the eyes of a math teacher who is also responsible for the professional development of his colleagues in his role of a principal. These responsibilities could be combined successfully as it will be shown by a specific example.

A problem of exploring the dimensions of stairs from different architectural traditions is presented in two aspects – as a long-term project activity of students and as a model of how the IBL could be implemented by other teachers possibly modified according to the specifics of their subject and the age of their students.

## 2. Stimulating the students to work in IBL style

The world around us provides a lot of options for us, as teachers, to show the students how it is related to mathematics and science. Usually we are so used to the surrounding objects that we do not think how they have been created. Take for example the stairs. They could be characterized by their rise (R) and their Going (G) measured for instance in centimeters.

At the beginning of the Mascil project (Maaß, 2013) I assigned my students (9-graders) the following practical task, organized as a field trip:

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**Task:** Go to the central area of the town. Split in 3 groups. Each group has to take a pictures of the stair of a particular building (the courthouse, the municipality and the theater), to measure the steps and determine their rise and going. Then the groups have to describe the material the stairs are made of, the number of the steps and anything they consider important. The captains of the groups present the results.

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The pictures taken by each group are shown in Figure 1. I myself carried out the same task for the school stairs.



Figure 1 Measuring the stairs of the town's Courthouse, Municipality, and Theater, respectively..

The students got as homework to explore and prepare a presentation about the stairs of their home.

The class session for analysis and generalization of the data was as follows:

- The three groups demonstrated their presentation about the buildings in the center of the town.
- We put the results of the measurements in a table and focused on the expression  $2R + G$  since according to the expert (as I had checked in a specialised journal) its value should be between 55 and 70 (Table 1).

Table 1. Title of the table (Caption style)

Building	R cm	G cm	$2R + G$ cm
Municipality	14	40	68
Courthouse	13	35	61
Theater	9	34	52

As seen from the table only the theater's stairs do not fit the standard requirements. After that several students presented the stairs of their homes and discussed if they were "right". This time the problem for homework was:

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**Homework :** Design two stairs for a total rise of 1 m. For each stair determine the number of steps, the rise and the going.

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Some students got so enthusiastic about exploring the stairs in different locations that they went on this activity during the summer holiday, including abroad (Figure 2). They demonstrated their findings in the first days of the next school year.



Figure 2 Measuring the stairs of the Central railway station in Bologna, Italy.

### 3. Sharing the IBL experience with the teachers

I don't require from my colleagues to implement IBL in their classes. Instead, I organize on regular basis sessions of sharing our good practices. This turns out to be a better idea than the traditional visits of the principal in a class setting which might create discomfort among the students and the teacher alike.

At such a "Share-your-practice" session I presented the two lessons on measuring and designing stairs and discussed the advantages of IBL in relation with students' motivation. Furthermore, I emphasized the role of tasks of this type for the development of key competences such as making choices and decisions, justifying and defending them and comparing different solutions (Kenderov et. al., 2015).

Other teachers shared their own good practices and we as a community discussed when and how IBL is applicable. The presentations of good practices are collected in the school archive and could be used in the future by younger colleagues.

Recently I found the Mascil Problem of January 2016 on designing a staircase and the guidance for teachers (<http://teacher-communication.mascil-project.eu/mod/resource/view.php?id=22914>). It gave me ideas of further investigations and explorations leading to a construction design. When working with new students (again in 9<sup>th</sup> grade) I am planning to discuss the problem of finding a relationship between the formula about the steps and the size of people. Such an approach of modifying, extending and enriching a problem when considered in a new context, with new students, is extremely important when working in IBL style.

### 4. Conclusion

My endeavor when working on the Stairs problem has been for the students to develop competences for observation, interest to investigations and explorations of the surrounding world of work, sense of initiative, cultural awareness and expression – all of them related to the key competences for the citizens of the knowledge/creativity based society.

In a system like the Bulgarian one in which teachers are expected to cover a relatively large volume of mathematical topics (even more so in a specialized school like ours), it is not very easy to convince the teachers that IBL would not be in a conflict with the results shown at standardized tests (Chehlarova et. al., 2015). But sharing the positive effects of my personal experience I feel optimistic, since the principal and his colleagues in the school are like-minded people and climb the stairs of the professional development together. In this climbing we are not alone as discussed by Kenderov et. al. (2016) – we are part of a community which grows and becomes stronger in its endeavor to integrate the IBL with WoW in mathematics and sciences education in Bulgaria.

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