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Second Chance School: Designing and carrying out numeracy applications in ICT environments

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Abstract

Notions like literacy, multi-literacy and multimodality introduce another dimension in adult education. Under this perspective, the aim of this study is to propose ways to solve mathematical problems that arise naturally in the context of everyday life with the use of ICT, thus showing that it is possible to design and apply such methods in adult numeracy. We present the didactic procedure of an activity in a dynamic geometry environment that was performed in the school's technology room with a sample of adult students, based on the principles of life long learning and in particular on a theoretical model by the New London Group.

Keywords: Adult numeracy, second chance schools, geometer's sketchpad, new London group, literacy

Introduction

We describe the didactic procedure of a two hour activity performed in the computer and technology room of the second Chance School of Rhodes. This activity employs mathematics and geometry in The Geometer's Sketchpad dynamic geometry environment (GSP) (Manual, 2000) to guide students to solve a real life problem.

Some of the didactic aims of adult numeracy that are closely related to the specific activity are: The students react to their daily practical mathematical needs (calculations, measurements, problem solving), decode data and define a problem presented in the frame of daily life, develop basic mathematical skills of communication, reasoning and critical thinking, recognize the general principles underlying partial phenomena, use mathematical knowledge and techniques in cross thematic activities, employ ICT to process elements from problems, model real situations and represent them digitally and use computer software to study and manipulate parts of geometry and spatial notions (Lemonidis, 2006).

Our general pedagogical orientation and philosophy

This is an initial study in an effort to implement a theoretical model by Cope & Kalantzis (2000) in the Second Chance Schools (SCS) in specific ICT environments. In the future, we scope to extend our results and practices more systematically by taking into account the notions of multimodality (Kress, 1998) and semiotic modes (Chontolidou, 1999) (Vekris & Chontolidou, 2004), specifically regarding the need to reevaluate the pedagogical and didactic character of literacy as proposed by The New London Group thesis (The New London Group, 1996).

One of the authors is also interested in exploring the ability of students to learn by a performance that resembles original scientific research (Pipinos, 2007).

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Let us note that in an interdisciplinary context, students in our school invest time during computer and mathematics classes to be instructed in dynamic geometry environments.

Theoretical model

According to the views of Kalantzis and Cope (2000), the teacher-instructor must take under consideration that a serious bulk of the adult students' knowledge actually comes from outside the official school room. Adults possess important skills and abilities, experience and expertise, through many forms of official or unofficial studies.

Their model comprises of the following phases (Cope & Kalantzis, 2000): Situated practice, in which effort is being made to investigate points of the problem in class that are related to the students' experiences from their daily life, their work environment or their specific social frame or background; overt instruction, an analytic and systematic understanding of the data that the adult students encounter in the previous phase of situated practice; critical framing, the cultivation of critical and metaknowledge mathematical skills that involves interpretation and critical consideration (correlations, comparisons and useful points) by the students in the natural setup of the problem; transformed practice, the transfer (application) of the problem and its solution methods to other social, communicative or cultural frames.

Characteristics of the student participants

18 adult students of the second year (B cycle) took part in this activity, of which 11 were female and 7 were male. Their ages range from 22 to 54 and they practise a wide spectrum of occupations, like construction workers, secretaries, freelancers, housewives, etc. Irrespectively of the different reasons they came to school, they all share a common goal: To increase their knowledge repertoire and develop new skills that might be useful in real life.

The problem of straightening the border between two land properties, or "Where do I put the line?"

Situated practice

This problem was brought to class by student Tsampikos, who is into the real estate business. He pointed out that «this particular problem was in my head and I was trying to solve it for my clients. I know that a solution exists, that it is possible, and I would like you to show me how".

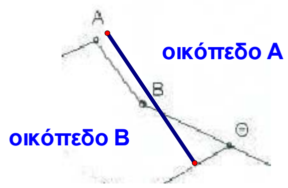

Figure 1. Where are we to place the line so that the two exchanged areas are equal?

Two adjacent land plots have an "ugly" border. As shown in Figure 1, there is a sharp triangular edge which spoils the optimal future positioning of a building. The two owners wish to exchange an equal amount of land in order to straighten their border. The question put to us is: where exactly must one place a straight line parallel to the existing border so that the two resulting areas are equal?

At this point the students were divided into six groups of three pupils each. They were asked to propose ways or methods that might lead to a potential solution, following discussion among them and based on their present knowledge. They suggested that we use the formulae for the area of a triangle and a trapezium and "try various positions for the straight line to test where the areas are equal".

Overt instruction

Each group made an informal sketch of the plots on grid paper with the aid of a ruler and a set square. This helped them to simulate the architect's plan in GSP (Figure 2). From dynamic point **P** they tried various positions for the required line while Sketchpad was simultaneously measuring the two areas **PKΓB** and **KΔM** (Figure 2). Thus, they were able to follow the way these areas varied with corresponding variations of position point **P**. They realized, empirically at least, that such a line actually exists. Naturally, the potentially more interesting part of the activity remained to be seen: to use mathematics to exactly calculate or construct the position of our line. The used methods would most probably extend to similar problems in other land plans.

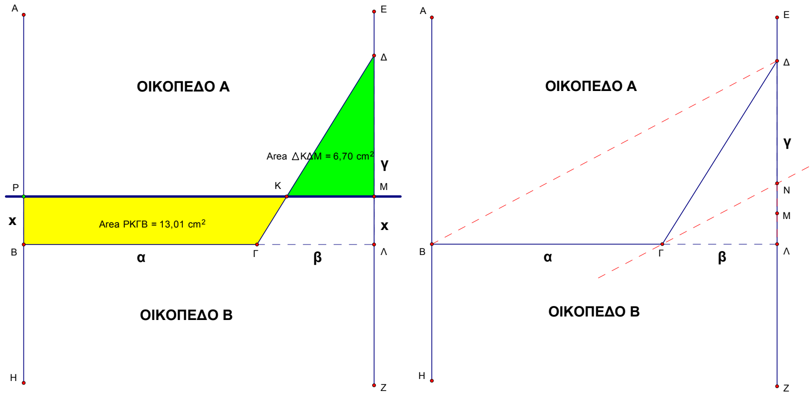

Figure 2. Algebraic considerations are founded and an elegant ruler and compass construction that can be applied digitally in any plan

Critical framing

Our students were asked to name the type of geometrical shape **PMΛB** and to write down the formula for its area and similarly for shape **ΓΔΛ**. They were next presented with the main idea: Areas **PKΓB** and **KΔM** are equal if and only if areas **PMΛB** and **ΓΔΛ** are equal! There was discussion on why this is actually true. (This idea is made easier to follow with the aid of this ICT environment). They all liked this idea as it immensely simplifies the formulae and the subsequent algebraic manipulations. The mathematical equation that expresses this condition is $(\alpha+\beta)x = \frac{1}{2}\beta\gamma$, a simple 1st degree equation. In this way the position x for the line is calculated algebraically.

However, we can give a purely geometric construction of this position by guiding our students towards the following idea: turn the algebraic relation into a ratio, then work backwards to find a suitable and simple geometric similarity construction which produces this ratio. This is not easy, even for high school students, as it involves inverse thinking abilities (Pipinos, 2010).

From point Δ we bring segment AB and the line parallel to this segment passing from point **Γ**. Let this line intersect **ΕΖ** at **Ν**. Then, the midpoint M of segment $N\Lambda$ provides the position of our line. Indeed, triangles **ΒΔΛ** and **ΓΝΛ** are similar, whence $\frac{2x}{\beta}=\frac{\gamma}{\alpha+\beta}$, a relation equivalent to our initial equation! (Figure 2).

Transformed practice

The students can now apply ruler and compass constructions directly on any digitally simulated plan. Actually, it is important to provide alternative solutions to problems, especially if these different solutions bridge seemingly separated areas of science. They can also appreciate that algebra and geometry are unbreakably interlinked, as all sciences are for that matter.

The methods developed in class were proposed by our student to the proprietors of the land plots, who considered them feasible solutions to their problem and decided to discuss it with their civil engineer.

Conclusions

Having positive indications from the students' performance and having observed that such a way of problem solving is effective, we believe that the gist of the above methods can be extended to a broader spectrum of mathematical setups in more systematic research.

For future studies, the multimodal role of semiotics can place a new challenge in the designing of any activity by the educator. This is a serious tool that can help our students increase their sense of self value and change their state of how they view certain learning matters when helped by ICT.

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