GeoGebra the rainbow over past, present and future

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Abstract: *The development of information technology radically changes our way of living, of communicating with the others, of receiving the information. In the future, it is expected that the role of computers in our life become essential; any student will have to master this field in order to achieve easily what he wishes.*

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1. Introduction:

Our life has changed its speed and this does not allow us to be connected with the attitude of contemplation. The notions of “to return to” or “to be late for”, to spend more time to re-reading, and to be involved into any action of contemplating, this could be the essence of the human culture. “To come back to”, “to reflect at” classical mathematical lectures, these could be a real revelation for some old generation but, impossible to be detected, more and more, to the young generation.

Some years ago we appreciated that the decade of the appearance of I-pods or smart-phones or tablets which cover our way of communication and transfer of information, will lead to a lot of important changes in our life. One of the domains most affected by this aspect could be the system of education and particularly the system of mathematical education.

The impact could be more important if we agree that this situation of “no longer takes time to deal with” has caused one kind of lock of interest in reading art or doing Mathematics.

Some ideas above have been presented by the Academician Solomon Marcus with the occasion of the Conference of “Annals of Braila”, on November 2013. This dissertation made us to reflect and to try to transfer the global situation, the paradigm of "to return to" in the context of GeoGebra Surrounding.

2. The paradigm of "to return to" with GeoGebra

In order to find out a strategy for connecting our students with the mathematical classical lecture and to make them "to takes time to deal with" and to construct a didactic success, we have to put together some ideas to be transferred in real action.

In order to not disturb their every day connection with the touch screen we have proposed the GeoGebra in the Android System. In order to "to return to reading, reflect and re-discover" we have proposed some lecture from the old collection of the Romanian Journal of the Romanian Society of Mathematics, "Gazeta Matematica", in an expedition which has considered some locus problems proposed long time ago, years 1870-1900.

Our strategy start with re-reading selective problems of math long time ago proposed to be resolved and to reconsider the degree of actuality of them. These problems will be analyzed in the context proposed some years ago in the GeoGebra lesson plans: Draw, build, unite, and investigate properties, change shape and size. Properties remain the same? Why? Can you formulate the theorem from this investigation? Prove it rigorously! Experience should not only be lived, but shared.

With this actions, the paradigm of „The GeoGebra Language" will not only be a working method but also a step in opening a viable way to exchange old, present and future ideas, cover the phenomena.

3. Problems of math, re-read and re-evaluates the context

The statement of the first problem: On the fixed line d, are considered the fixed points A and B in the plane and the mobile point M. In the plane are built regular polygons of [AM] and [AN] sides, with m, respectively n number of sides, where m,n ЄN, m,n≥3. The circumscribed circles of those polygons are intersected in M and P, (Fig.1). Is required the geometric locus of P**.**

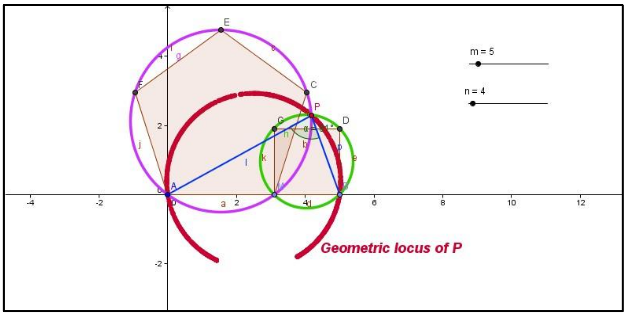

Figure 1: Geometric locus of P for m=5 and n=4

After the investigation with GeoGebra software, some different results could be raised. The geogebra application shows in a real time all the changes and will allow the changing of m and n for different values with the sliders, (Fig.2).

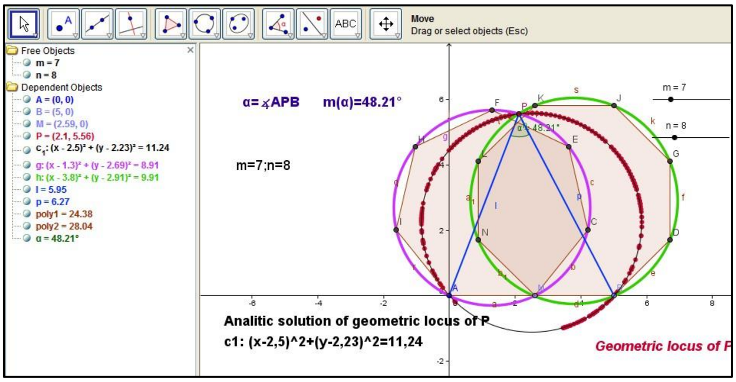

Figure 2: Geometric locus of P for m=5 and n=4

The statement of the second problem: Miquel's Five-Circle Theorem is among a sequence of wonderful theorems in plane geometry bearing his name. Let P1, P2, P3, P4 and P5 be five points.

Let Q1=P2P5∩P1P3, Q2=P1P3∩P2P4, Q3=P2P4∩P3P5, Q4=P3P5∩P1P4, and Q5=P1P4∩P2P5.

Let the other intersections of the consecutive circumscribed circles of triangles Q5Q1P1, Q1Q2P2, Q2Q3P3, Q3Q4P4, and Q4Q5P5 be M1, M2, M3, M4, and M5 respectively. Prove that M1, M2, M3, M4 and M5 are cyclic, (Fig.3).

There are a lot of interesting proofs of this theorem. Miquel's Five-Circle Theorem is difficult to prove algebraically.

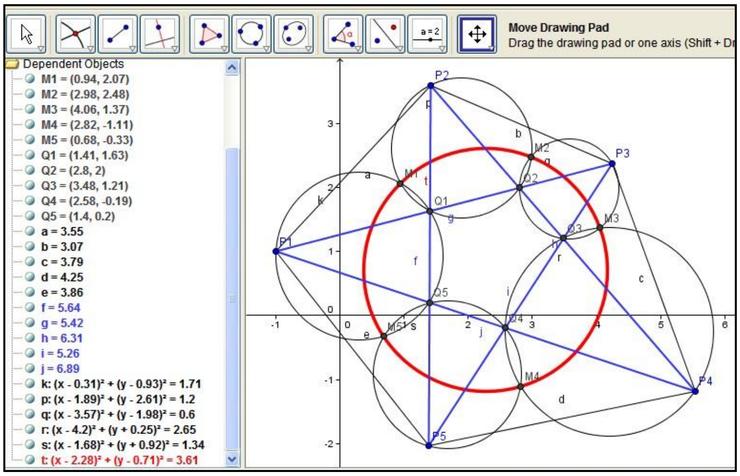

Figure 3: Miquel's Five-Circle Theorem

When n = 3, the three vertices of a triangle are on a unique circle, which can be taken as the unique circle determined by the three edges of the triangle, called the *Miquel 3-circle*, (Fig.4). When n = 4, the 4 edges of a quadrilateral form 4 distinct 3-tuples of edges, each determining a Miquel 3-circle, and Miquel's 4-Circle Theorem says that the 4 Miquel 3- circles pass through a common point (i.e., are concurrent), called the *Miquel 4-point*, (Fig.5). This combination of perspectives allows the teacher to demonstrate, in front of students and together with them, strategies revealing the "behavior" of figures. Connections between different representations of math concepts will accomplish here the necessary background for better understanding, steady knowledge of mathematical literature.

One appreciates the pedagogical implications of exploring geometry in a dynamic environment, both as an investigation tool and as a demonstration one, the connection between math educators and specialists in informatics being one of the best and a challenge at the same time. The term of “Dynamic-Info-Geometry” could be a method of math teaching and the start of future investigations in applied mathematics.

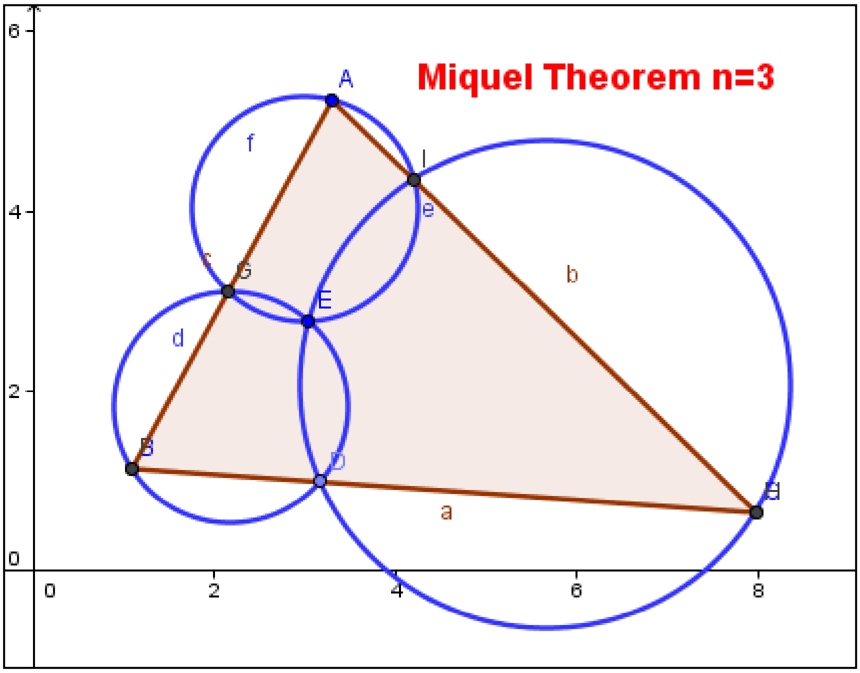

Figure 4: Miquel's 3-Circle Theorem

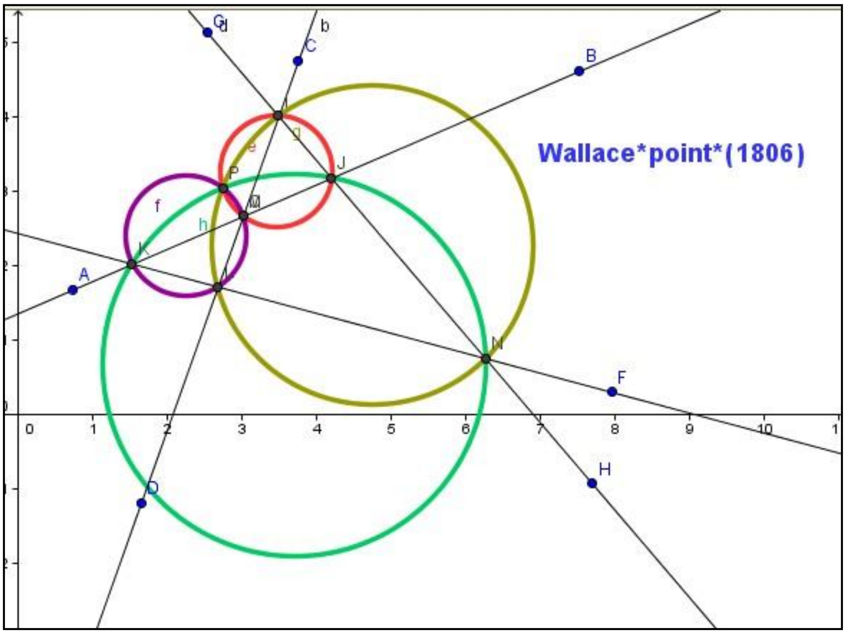

Figure 5: Miquel's 4-Circle Theorem. The position of A, B, F, could be modified but the four circles will have a common point P, the Wallace point

GeoGebra provides good opportunity for students to work in pairs and talk through the project together. Attractive presentations prepared in advance, not only capture students' attention but also may lessen the immediate cognitive load for educated and educators. In addition to what is traditionally recognized as benefits, a lot of teachers often use real world models. In order to enhance the image mathematics by creating a "halo effect", the proposed efficient space for this will be the GeoGebra platform. The teachers who use GeoGebra must be more specific, more "open minded", willing to allow for experimentation, and give more guidance at the start of any GeoGebra experiment. Dynamic geometry offers opportunities to bring the real world into the classroom, adding visualization, color and animation. This would not be possible in a traditional classroom. This GeoGebra thinking is expected in various topics of the curriculum but, if they are not found there, we shall connect the GeoGebra thinking with topics and other different experiences, in a model of more efficient curricula.

We live in a world subject to dynamic changes. The level of information and its flow on different communication channels, its impact on the individual are more and more difficult to quantify. Filters of the informational flow, imposed by the educational system, may lead to progress when this approach is in agreement with a modern and well planned educational desideratum or may lead to disasters when it is imposed by social or political manifestations which are not focused on the development of the individual.

4. Conclusion

The teachers who use GeoGebra must be more specific, more **"open minded"**, willing to allow for experimentation, and give more guidance at the start of any GeoGebra experiment.

Flexibility of learning means flexibility of relation between teachers and students. This implies **new situation of learning** and a special development of new methods of teaching.

The adequately integrating any such approaches into projects can lead to the development of **'meta-mathematical' skills**, which are particularly useful in technological instruction and technology applications. On the social side, the impact of GeoGebra may be important in **shifting perceptions about mathematics** as a **solitary activity** to the **more harmonic view** of mathematics as social activity. The paradigm of the "re-reading" could be the rainbow between of all these activities.

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