

THE POWER OF GEOMETRY IN THE CONCEPT OF PROOF

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Short description of the workshop: aims and underlying ideas

At the workshop we aim to show that the best motivation for learning is to challenge student's thoughts. Through intuitive geometric statements human brain instantly poses smart questions and offers hypotheses while engaging in self challenging explorations. Using in our schools too often neglected geometry, engaging teaching can be achieved almost without words in contemplative pantomime settings. The aim of the workshop is therefore to show the power of geometry in the development of the concept of proof. Several relatively easy geometric ideas will be presented through simple mind provocative questions and by the use of technology. The aim of these questions is not solely to motivate the answer, but is much deeper and educationally wider. Namely, the aim is to motivate the understanding and the beauty of the resolved uncertainty brought by the certainty of a proof. In a way, a proof should be as much an emotional experience as a rational achievement. Participants will be challenged with several mind provoking questions, followed by individual engagements in the form of short problem solving sessions and concluded by joint discussions. By the use of geometry, we aim to show, that to learn and appreciate mathematics, one needs to understand the concept of proof. And in order to understand the concept of proof, one needs to experience the challenge of uncertainty that precedes the certainty of a proof.

Planned structure:

In a short introduction we will give an outline of the workshop aims. That is to present and experience the challenge and beauty of understanding, which can nicely be done by observing our reasoning through intuitive geometric communication.

Within a general discussion with participants initiated by some smart questions and tricks, we will observe our curiosity, comprehension and our concepts of proofs.

In the main part of the workshop, we will present, discuss and work on several nice (mainly geometric or geometrically presented) problems. Within those we will address several cognitive aspects that precede the need and concept of proof. All of the problems will be very easy to formulate. Some of the problems will be formulated without words by the use of technology (via visual geometric observations). Participants will be challenged to formulate problems 'formally' and to explore several 'upgrades of understanding'. With some, participants will get hands on physical experience. Proof will be introduced as cognitive solution and conclusion to 'provocative uncertainty'. In most cases, we will argue (and show) that for a proof to be 'an emotional experience' (that is to come as a solution to experienced problem), it is very important how the problem is introduced.

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In ‘sum it up’ conclusion we will comment and provoke participants feed-backs. Discussion will be guided by questions, some challenging and provoking understanding of the previously discussed content.

In a short final conclusion also internet access to interactive dynamic presentations/visualisations will be presented to participants.

Planned timeline	Topic	Material / Working format / presenter
5 minutes	Introduction, outline of aims, challenge and beauty of understanding	/ talk / Kobal
15 minutes	Discuss and experience: challenge, curiosity, comprehension, proof	‘tricks’ / discussion / Kobal
55 minutes	Several (geometric) challenges: <ul style="list-style-type: none">• Missing angle of a triangle• Midpoints of a quadrilateral• Apparent regular octagon• Line through centroid• Intersection of two squares• Triangle on top of a square• Geometric series formula• Parabola geometrically• Ellipse by folding paper• Parabola-ellipse analogy• Geometric paradoxes• Sound technology geometrically• Other	Handouts, LCD dynamic presentation /discussion, problem solving /Kobal
10 minutes	Sum it up conclusion, feed back	/ discussion guided by questions / Kobal
5 minutes	Dynamic applets information, conclusion	GeoGebra applets: http://uc.fmf.uni-lj.si/Hamburg2016/ / talk / Kobal