

## **VITALmaths – Transforming learning experiences through mathematical video clips**

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### **Abstract**

This paper provides an overview of the VITALmaths project (Visual Technology for the Autonomous Learning of Mathematics), a collaborative initiative between the School of Teacher Education of the University of Applied Sciences Northwestern Switzerland (PH FHNW) and the FRF Mathematics Education Chair hosted by Rhodes University in South Africa. This project seeks to produce, disseminate and research the efficacy and use of a growing databank of short video clips designed specifically for the autonomous learning of Mathematics. A dedicated website has been established to house this growing databank of video clips ([www.ru.ac.za/VITALmaths](http://www.ru.ac.za/VITALmaths)) from which the video files can either be freely downloaded or streamed. Specific to the South African context is our interest in capitalising on the ubiquity of cellphone technology and the autonomous affordances offered by mobile learning. This paper engages with a number of theoretical and pedagogical issues relating to the design, production and use of these video clips, a number of which will be shown during the presentation.

### **Introduction**

Among the implications that can be expected from the implementation of the National Educational Standards in Switzerland, as well as a number of other European countries, the following three appear to be most important for Mathematics education (Linneweber-Lammerskitten & Wälti, 2008): (a) It will be necessary to find better ways to deal with heterogeneity, particularly with regard to supporting weaker pupils; (b) It will be necessary to give more attention to the non-cognitive dimensions of Mathematical competency such as motivation, sustaining interest and the ability to work in a team; (c) It will be necessary to deal with aspects of Mathematical competence such as the ability and readiness to explore mathematical states of affairs, to formulate conjectures, and to establish ideas for testing conjectures.

These necessities find resonance with similar implications which have arisen from the implementation of the Revised National Curriculum Statement in South Africa. This is true not only in terms of subject-specific outcomes and assessment standards, but it is also echoed by the social transformation imperatives of the curriculum and the desired attributes of the kind of learner envisaged within the South African education system (Department of Education, 2002, 2003).

Bearing in mind that these educational standards and curriculum statements are representative of the minimum levels of knowledge and skills achievable at each grade, it follows that the establishment of such aspects of competence as minimal

standards *for all pupils* can only be successful if appropriate measures are taken to (a) fully integrate weaker pupils in the learning experience and (b) create an environment that is stimulating, motivating, interesting and encourages social competence. The VITALmaths project began as a response to this challenge of developing auxiliary means that could not only release teachers from the frontal introduction to mathematical themes, but also provide an opportunity for learners, particularly weaker learners, to experience genuine and challenging mathematical activities and explorations.

### Autonomous learning through video clips

Although the use of video clips in the pedagogical context of the classroom is nothing new, the majority of these videos tend to be instructional in nature and consequently are underpinned by specific pre-determined outcomes and pedagogical imperatives. The VITALmaths project was born out of the identification of a need for short, succinct video material that could be swiftly and easily accessed and used autonomously by both teachers and pupils alike. Common design principles of these video clips are that they are short, aesthetically delightful, and are self-explanatory in the sense that they require minimal instruction. An important aspect of these video clips is that they encourage genuine mathematical exploration that transcends the mathematical content of the film by encouraging a desire to experiment, use trial-and-error, formulate conjectures, and generalise results.

VITALmaths video clips are silent, short in duration (typically 1 to 3 minutes), and are produced using a stop-go animation technique incorporating natural materials as opposed to high-tech graphics. The video clips explore and develop mathematical themes in a progressive manner that supports and encourages genuine mathematical exploration. These themes include, amongst others, striking visual approaches to proving the Theorem of Pythagoras; patterns and symmetry generated through tiling activities; elegant visual support for various results from elementary number theory; interior angles of polygons; equivalence of different area formulae; visual insight into numerical operations. A dedicated website has been established to house this growing databank of video clips (<http://www.ru.ac.za/VITALmaths>) from which the video files can either be freely downloaded or streamed. A selection of screenshots is shown in Figure 1.

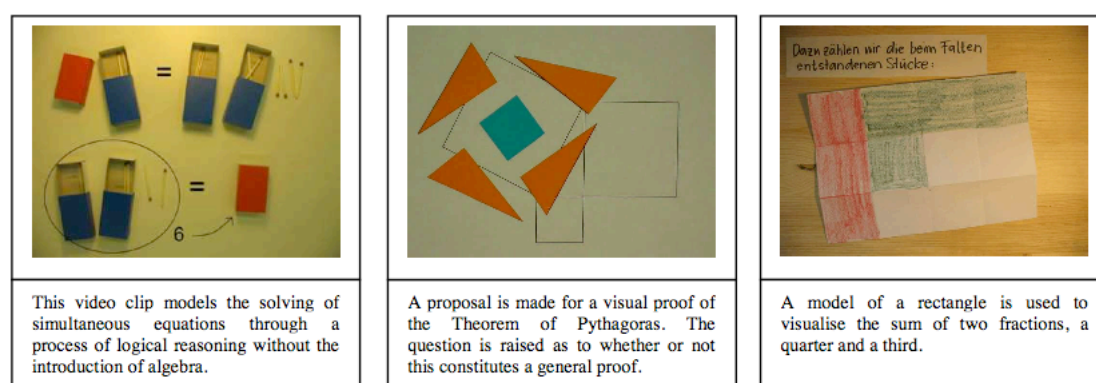


Figure 1. A selection of screenshots from three VITALmaths video clips.

One of the guiding tenets behind the project is that of autonomy. Autonomy represents an inner endorsement of one's actions – a sense that one's actions emanate from within and are one's own (Deci & Ryan, 1987 as cited in Reeve & Jang,



2006:209). As Mousley, Lambdin and Koc (2003) succinctly comment, “Autonomy is not a function of rich and innovative materials themselves, but relates to genuine freedoms and support given to students” (p. 425). Thus, teachers cannot directly provide learners with an experience of autonomy (Reeve & Jang, 2006), but rather they need to provide genuine opportunities that encourage, nurture and support autonomous learning. Being sensitive to this, critical elements of the design principles of the video clips take into account both cognitive and non-cognitive dimensions.

### Design principles & design process

Of fundamental importance to the VITALmaths project are the design principles on which the video clips are modelled, since this plays a critical role in terms of how students are likely to interact with the technological medium. At the heart of this design process is the notion that designers design the *experience*, not simply the *product*. The basic design cycle is shown in Figure 2.

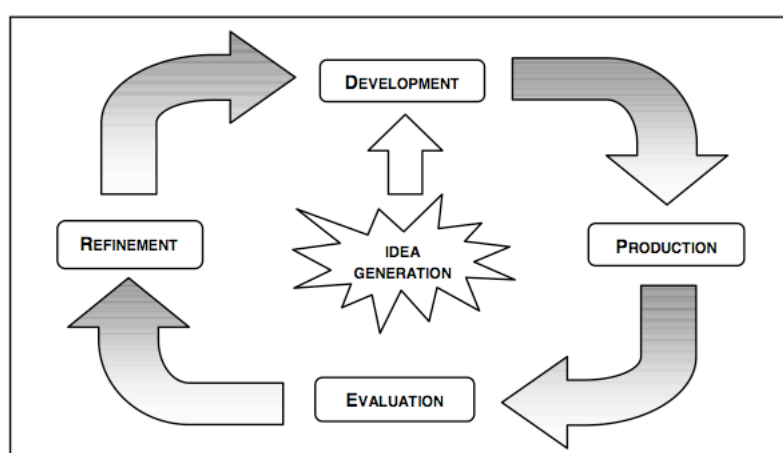


Figure 2. The design cycle.

The idea generation process is multi-faceted. One aspect of the VITALmaths project relates to the production of video clips specifically aligned with certain textbooks used in Switzerland. The idea here is that teachers will be able to use these clips as an auxiliary means to the introduction of new mathematical themes thereby allowing more time to focus on weaker pupils. However, another important aspect of the project is the production of video clips that are purposefully *not* aligned with the mathematical content of school curricula. It is envisaged that these video clips will be used in the preparation of exploratory lessons, for personal conceptualisation of mathematical concepts, and as motivational and explanatory tools, with the emphasis lying on teachers and learners using them as autonomously and independently as they wish. Ideas of appropriate topics are sourced from teachers, pupils, and experts in the field. In addition, we are exploring the possibility of a group of pupils conceptualising and creating their own video clips as part of a school Design & Technology project.

Once an idea has been generated it is developed into a workable video clip. In terms of the design principles that relate specifically to the video clips themselves, a purposeful decision was taken to eschew high-tech graphics animations in favour of using natural materials. This design consideration supports autonomous learning on two levels. Firstly, in terms of cognitive access, the use of natural materials should allow for a more direct and personally meaningful engagement with the content of the video clips when compared with the additional abstract dimension associated with high-tech graphics animations. Secondly, learners will be able to personally source all

the required material to explore identical or similar scenarios, thus encouraging hands-on mathematical exploration that will have personal meaning for each learner. The production process presently used incorporates a stop-go animation technique using the free software *VideoPad Video Editor*. Once the video files are created they are then converted from AVI format to both MP4 and 3G2 formats. The MP4 format is appropriate for PCs, laptops, iPhones and most cellphones. The 3G2 format is appropriate for older cellphones that aren't MP4-compatible.

The evaluation process relies on feedback from teachers, learners and experts in the field, and is continuously used to reflect on and refine both the production process itself as well as the design principles that inform the conceptualisation of the video clips. This feedback forms a critical component of the refinement stage of the design cycle in which video clips are either modified or reconceptualised.

### **Mobile technology**

Specific to the South African context is our interest in the use of cellphone technology as the primary distribution platform for these video clips. Our interest lies not only in the use of cellphone technology as a means of viewing the video clips, but ultimately as their primary distribution platform. Not only will cellphone technology enhance and support the autonomous learning objective of the enterprise, but it will greatly facilitate access to these video materials. In addition, it is anticipated that this innovation will have a significant positive impact for teachers in deep rural settings where access to mathematics resources is very limited.

There are a variety of mobile devices that have found application within the education arena - Personal Digital Assistants (PDAs), tablet PCs, iPods, and some games devices. However, fuelled by the development of powerful telecommunication networks which support an ever increasing range of data access services, coupled with technological advances and steadily declining costs of cellphones themselves, cellphones have emerged as a viable option for mobile learning. The VITALmaths project aims to capitalise on the flexible and versatile potential of cellphones for mobile learning.

The educational potential for mobile learning afforded by cellphone technology is diverse (Kolb, 2008; Prensky, 2005). Within South Africa a number of projects have already harnessed the ubiquity of cellphone technology to support the learning of Mathematics (e.g. ImfundoYami / ImfundoYethu, *M4Girls*, *MOBI<sup>TM</sup> maths*, and *Dr Math*). Selanikio (2008) makes the pertinent comment that “for the majority of the world’s population, and for the foreseeable future, the cell phone is the computer”. This sentiment is echoed by Ford (2009) in her pronouncement that “the cellphone is poised to become the 'PC' of Africa”. The challenge for educators is thus “to capitalize on the pervasive use of cell phones by younger students for educational purposes” (Pursell, 2009:1219). The VITALmaths project aims to take up this challenge and to capitalise on the flexible and versatile potential of cellphones for mobile learning.

### **Conclusion**

The VITALmaths project began as a response to the challenge of developing auxiliary means that could not only release teachers from the frontal introduction to mathematical themes, but also provide an opportunity for learners, particularly weaker learners, to experience genuine and challenging mathematical activities. The desire for teachers and learners to make autonomous use of the video clips is supported by



the broad and open philosophy embraced by the design principles on which the video clips are conceived. The video clips are short, succinct, visually and intellectually appealing, relevant and mathematically inspirational, and a growing databank of video clips has been established from which they can be freely downloaded (<http://www.ru.ac.za/VITALmaths>).

The broad and open philosophy embraced by the design principles on which the video clips are conceived aims to encourage teachers and learners to use the video clips as autonomously as they desire. Continued research into the use and impact of these video clips seeks to develop a base for sustained growth and development, while at the same time contributing and participating in the academic discourse surrounding the use and development of visual technologies in the Mathematics education arena.

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