

Please make sure that your application supports the criteria listed in the details on the Application Process

Date Application Received

Small Grant Bid Title

Establishing a professional development network with an open-source dynamic mathematics software - GeoGebra

Applicant Details

If you are applying as part of a consortium, this should be the lead applicant

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Why are you interested in studying this area and do you know any other relevant research in this area? (see [Guidance Document SG1](#))

GeoGebra (www.geogebra.org) is **open-source dynamic mathematics software** with rapidly growing worldwide popularity, especially in Europe and North America (Hohenwarter & Preiner 2007). This dynamic software package incorporates geometry, algebra, and calculus that other packages treat separately into a single easy-to-use package (spreadsheet and computer algebra extensions are soon to be added to the software). GeoGebra is available **free of charge** and thousands of teachers and students both in classrooms and at home use it around the world (see in additional information). However, research suggests that, for the majority of teachers, solely providing technology is insufficient for the successful integration of technology into their teaching (Cuban, Kilpatrick, & Peck, 2001). It has been suggested that adequate training and collegial support boost teachers' willingness to integrate technology into their teaching and to develop successful technology-assisted teaching practices.

Most teachers who are currently using GeoGebra have not received any training in the use of the software, but have begun using it due to their enthusiasm or encouragement by their colleagues (Hohenwarter & Lavicza, in press). Besides small clusters of workshop activities at different locations there is no, or at least none that we could trace, organized GeoGebra-related professional development programmes for in-service teachers. To be able to reach teachers who require support and to provide free professional development with GeoGebra Hohenwarter and Lavicza will establish an International GeoGebra Institute (IGI) **in the United States (US)** in the spring of 2008. The principal aims of IGI are to promote the learning and teaching of mathematics by providing free software, offering free training for teachers, improving the software based on user feedback, and coordinating research activities in relation to GeoGebra. With the support of a **grant (\$250,000) by the National Science Foundation (NSF)**, a multi-stage professional development programme is currently being developed at Florida Atlantic University (FAU) under the supervision of Dr Hohenwarter, the developer of GeoGebra. Within this programme teachers are trained and sent to offer GeoGebra workshops throughout the US. In addition, several research projects have been developed to improve the software and the training programme. Using the expertise and the materials developed at the FAU-IGI site researchers and teacher educators are adopting similar programmes and preparing the establishment of local IGI sites in Luxembourg, Norway, and Spain. The primary aims of the proposed project are to review, to modify, and to implement the materials developed at the FAU-IGI for professional development purposes in England. In addition, the project aspires to nurture a community of teachers and researchers in England (based on the website visits there are already hundreds of teachers who use GeoGebra in England) who are interested in developing and using open-source technology in schools and in teacher education. Furthermore, in the long run, this project will provide a basis for establishing IGI sites around England.

References:

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining the apparent paradox. *American Educational Research Journal*, 38(4), 813-834.

Hohenwarter, M., & Lavicza, Z. (in press). Mathematics Teacher Development with ICT: towards an International GeoGebra Institute. In D. Hewitt (Ed.), *Proceedings of the British Society for Research into Learning Mathematics Day Conference, 17 November, 2007*. University of Northampton, Northampton, UK: BSRLM.

Hohenwarter, M. & Preiner, J. (2007). Dynamic mathematics with GeoGebra. *Journal of Online Mathematics and its Applications*, MAA, ID 1448, vol. 7, March 2007.

A summary of the study

Please give a brief summary (500 words maximum) of your proposed study. This must define the focus of the study and show how it will support the vision of the NCETM. It should show what will be the practical benefits of the study. (see [Guidance Document SG2](#))

(In this section and those below you need to make sure that you cover all the criteria for selection)

The principal aim of the project is to conduct research on an existing introductory-level GeoGebra professional development programme and establish criteria for its adaptation in the English context. The study will be conducted through tight collaboration of educational researchers and mathematics teachers in England.

Within the NSF Mathematics and Science Partnership (MSP) initiative in the US a multi-level professional development programme is being developed to offer training for teachers in the use of the open-source dynamic mathematics software GeoGebra. In our proposed project, teachers and researchers will meet 4 times to review this existing material and modify the materials and pedagogical approaches based on the analysis of data collected in workshops.

The project team will consist of **4 mathematics teachers from England** who have already demonstrated innovative use of GeoGebra in their own classrooms, **two mathematics education postgraduate students** at the University of Cambridge, Markus Hohenwarter the author of GeoGebra, and Zsolt Lavicza an educational researcher in Cambridge. The team will begin reviewing the existing professional development material in March 2008 and exchange recommendations for modifications during the following two months. This period will be followed by a one-day meeting in Cambridge, right after the GeoGebra Institute conference which prepares the establishment of IGI sites throughout Europe, to finalize changes in the workshop materials, to agree on pedagogical approaches, and to outline strategies for workshops. After this meeting participating **teachers will organize and provide full-day workshops for teachers in their local area**. Research assistants will support in these workshops, carry out observations, distribute questionnaires, and conduct interviews with workshop participants. Experiences from these workshops will be discussed on-line and during a half-day meeting in June. This day will also be utilized to give a **joint workshop for teachers associated with the NRich project** as they might become future trainers in proposed IGI sites in England. After the joint workshop the team will hold a debriefing of the project. During the summer, RAs will transcribe the audio-taped meetings and interviews, tabulate questionnaire data, and organize observation notes. The preliminary analysis of the data will be carried out by the PIs and the RAs which will be followed by a **presentation of preliminary results at the Regional NCETM seminar** and a whole-team meeting in October. During this meeting the team will analyze data, modify materials according to findings, and design a follow-up questionnaire for workshop participants.

In November 2008, an on-line follow-up questionnaire will be sent to participants of the workshops. The entire project team will organize whole-day working group session at the British Society for Research into Learning Mathematics (**BSRLM**) conference. This conference will give the team an opportunity to disseminate results for mathematics education researchers and generate interest towards GeoGebra-related issues. After the analysis of follow-up questionnaires, the **final report of the project will be presented at the NCETM Regional seminar** in February and the **NCETM-ATM conference** in April 2009. Certainly, project reports will be presented at other national and international conferences and the developed materials will be shared on both the **NCETM and IGI websites**.

Project Organisation including Time line that specifies start date and duration

Activity	Time
Review and on-line discussion of FAU-IGI professional development material	1 March – 9 May 2008
Cambridge meeting 1	10 May 2008
4 workshops held by participating teachers	May – June 2008
Cambridge meeting 2 – NRich workshop	Mid June 2008
Data organization and analysis	July – End of October 2008
NCETM Regional seminar work-in-progress presentation	September 2008
Cambridge meeting 3 – data analysis	End of October 2008
Sending follow-up on-line questionnaires	Beginning of November 2008
BSRLM conference working group session	Mid November 2008
Paper writing	November – February 2009
NCETM Regional seminar project report	February 2009
NCETM – ATM Conference – project report	April 2009

What is already known in this area?

Cuban, Kirkpatrick & Peck (2001) suggest that for the majority of teachers the use of computers only sustains rather than alters existing patterns of teaching practice. It is widely recognised that if the goal is to achieve what the English government's Training and Development Agency for Schools has identified as a national priority for continuing professional development (CPD) of teachers in relation to 'pedagogy' there is an increased need to change teachers' teaching practices (O'Mahony, 2007). However, for example Prensky (2001) in line with many other researchers argues that changing teachers' practice is a rather difficult task. Therefore, careful planning is needed for designing ICT-related professional development programmes for mathematics teachers to be able to affect their teaching practices.

Nevertheless, a recent report by Younie (2006) which examines the lessons learnt from national research and evaluation studies of ICT in schools in the UK argues that the "impact of ICT initiatives on teachers' classroom use of ICT has remained problematic". CPD of teachers was identified as one of the most problematic areas in Younie's report. The New Opportunity Fund (NOF) sponsored by the Department of Culture, Media and Sport (DCMS) was given responsibility for Lottery-funded ICT-related teacher training and policy directions were outlined by the Department for Education and Skills (DfES) and the Teacher Training Agency (TTA). Despite this complex intervention many teachers reported dissatisfaction with the training provided on the grounds that it was disorganised, lacking focus, too fragmented and text based (Younie, 2006).

The evaluation of this effort suggested that overall the NOF has contributed to increased teacher confidence with computers, but "only rarely to the pedagogic expertise to help them make the most effective use of ICT in their lessons" (Ofsted, 2001). It was identified that in spite of teachers' enhanced ICT skills the use of technology in their teaching was largely unproductive and inconsistent.

In our proposed project we will pay attention to the difficulties that various CPD programmes faced in the past. Our goal is to work together with experienced teachers and involve them in research and in the development of CPD materials. In addition, we will continuously collect feedback from workshop participants and aim to improve our programme together with the participating teachers. Moreover, ultimately we hope that teachers will form a self-sustaining community that will drive the future improvement of workshop materials in England.

References

Cuban, Kirkpatrick and Peck (2001). High Access and Low Use of Technologies in High School Classrooms: Explaining an Apparent Paradox, *American Educational Research Journal*, 38(4), 813-834

- Office for Standards in Education (Ofsted), (2001). *ICT in Schools: The Impact of Government Initiatives*; an Interim Report, London: HMI 264
- O'Mahony, D. (2007). *How can I use Moodle, a collaborative online learning environment, to improve my practice as a history teacher, as I encourage my pupils to think critically?* MSC thesis (School of Education, Dublin City University).
- Prensky, M. (2001). *Digital Natives: Digital Immigrants, On the Horizon* (NCB University Press, Vol. 9 No. 5, October 2001).
- Younie, S., (2006). Implementing government policy on ICT in education: Lessons learnt, *Journal of Education Information Technology*, 11: 385-400

Monitoring and evaluation

Describe your monitoring and evaluation system and give the name of the mentor/evaluator who will support the study (see [Guidance Document SG3](#))

The **external evaluator**, of the project will be present at every project meetings and all data will be shared with the evaluator. The external evaluator will review papers and reports of the project. In addition, the evaluator will chair the working group session at the BSRLM conference. The proposed evaluator of the project is **Dr Keith Jones**, School of Education, University of Southampton (<http://www.education.soton.ac.uk/staff/KeithJones>). Dr Jones has an extensive experience in evaluating and supervising research projects in mathematics education. In addition, Dr Jones co-ordinates the *Geometry Working Group* for the British Society for Research into Learning Mathematics (BSRLM) and was the leader of the working group on *Tools and Technologies in Mathematics Didactics* for the European Society for Research in Mathematics Education (ERME). We are certain that Dr Jones will be an excellent evaluator and mentor of the project.

Dissemination plan (locally and nationally)

This should place the NCETM portal and regional infrastructure centrally in your plan

All workshop materials and reports will be shared on the websites of NCETM and the International GeoGebra Institute (www.geogebra.org/IGI). Results of the study will be presented at regional and national NCETM meetings as well as at other teacher and academic conferences. In addition, similar projects with comparable data will be carried out at numerous locations throughout the US and Europe. Thus, the project offers an excellent opportunity for researchers around the world to engage in international comparative research. One of the major aims of IGI is to create a network of researchers internationally and coordinate/support research activities in relation to GeoGebra. This project can offer a seed for interested English researchers and people associated with NCETM to become involved in such activity with their colleagues around the world.

Any other information that will support your application

GeoGebra is free software that is available in **35 languages and runs on virtually any operating system**. It is an easy-to-use, versatile tool for visualising mathematical concepts from elementary through college level. GeoGebra offers the opportunity for **teachers to create interactive online learning environments to foster experimental and discovery learning**. In addition, due to the open-source nature of the software, GeoGebra can also be modified to local needs. Furthermore, GeoGebraWiki and the user forum provide platforms for sharing **free interactive teaching materials** and support from fellow users. Moreover, unlike commercial products, students are not constrained to use the software only in schools allowed by site licenses. The number of visitors on the GeoGebra website, www.geogebra.org, has doubled approximately every 6 months since 2005. Currently, the **website attracts about 300,000 visitors per month from 188 countries**. It can be estimated that more than 100,000 teachers use the software for their teaching around the world. Besides some workshops offered by Hohenwarter in Europe and the US the software is picked up by enthusiastic teachers and teacher educators on their own. The first initiative to offer wide ranging training is being developed at Florida Atlantic University through an NSF grant. In addition, the Florida Department of Education recently endorsed the software and projects to use it in Florida schools. Furthermore, shortly after the idea of an International GeoGebra Institute was born researchers and teacher educators in Luxembourg, Norway, and Spain are determined to establish IGI sites in their own countries. On 7-8 May, the first meeting of IGI will be held in Cambridge to discuss the establishment of IGI sites in North America and Europe.

Brief CV of lead applicant

Zsolt Lavicza

Current position

Teaching/Research Associate, University of Cambridge

Education

PhD in Mathematics Education, Expected submission: January 2008

University of Cambridge

Supervisor: Dr Paul Andrews

MPhil in Mathematics Education, September 2005

University of Cambridge

Supervisor: Dr Paul Andrews

Master of Arts in Mathematics Education, December 2004

University of Michigan, Ann Arbor, Michigan

Advisor: Professor Hyman Bass

Master of Science in Mathematics, June 2001

University of Cincinnati, Cincinnati, Ohio

Advisor: Professor Donald A. French

Bachelor of Arts in Mathematics with Teaching Certificate (PGCE equivalent), June 1998

Bachelor of Arts in Physics with Teaching Certificate (PGCE equivalent), June 1998

University of Szeged, Teacher's Training College, Szeged, Hungary

Publications

Lavicza, Z. (2007). Factors influencing the integration of Computer Algebra Systems into university-level mathematics education. *International Journal for Technology in Mathematics Education*. 14(3) 35-43

Hohenwarter, M., & Lavicza, Z. (in press). Mathematics Teacher Development with ICT: towards an International GeoGebra Institute. In D. Hewitt (Ed.), *Proceedings of the British Society for*

Research into Learning Mathematics Day Conference, 17 November, 2007. University of Northampton, Northampton, UK: BSRLM.

- Andrews, P., & Lavicza, Z. (submitted). English teachers' participation in school change. In N. Arato, L. Collet, T. Evers, A. Menlo (Eds.), *A cross-cultural study of teacher participation.*, Symposium Books, Oxford
- Lavicza, Z. (2007). Mathematicians' uses of Computer Algebra Systems in mathematics teaching in the UK, US, and Hungary. Proceedings of the CETL – MSOR Conference, University of Birmingham, Birmingham, UK
- Lavicza, Z. (2006). The examination of Computer Algebra Systems integration into university-level mathematics teaching. In L. H. Son, N. Sinclair, J. B. Lagrange & C. Hoyles (Eds.), *Proceedings of the ICMI 17 study conference: Background papers for the ICMI 17 study.* (pp. 37-44) Hanoi University of Technology, Hanoi, Vietnam.
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- Lavicza, Z. (in press). The examination of technology use in university-level mathematics teaching. *Proceedings of the Symposium on the Occasion of the 100th Anniversary of International Commission on Mathematical Instruction.* Rome, Italy
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- Lavicza, Z. (2005). Computer algebra related conceptions and motivations of university mathematics lecturers – an international study. In D. Hewitt (Ed.), *Proceedings of the British Society for Research into Learning Mathematics Day Conference, 11 June, 2005* (pp. 49-54). Open University, Milton Keynes, UK: BSRLM.

Markus Hohenwarter

Current position

Visiting Professor, Florida Atlantic University

Education

PhD in Mathematics Education, February 2006
University of Salzburg, Austria
Supervisor: Dr Karl-Josef Fuchs

Master of Science in Mathematics Education, March 2002
University of Salzburg, Austria
Supervisor: Dr Karl-Josef Fuchs

Master of Science in Computer Science, June 2002
University of Salzburg, Austria
Supervisor: Dr Jochen Pfalzgraf

Publications

- Hohenwarter, M., & Lavicza, Z. (in press). Mathematics Teacher Development with ICT: towards an International GeoGebra Institute. In D. Hewitt (Ed.), *Proceedings of the British Society for Research into Learning Mathematics Day Conference, 17 November, 2007*. University of Northampton, Northampton, UK: BSRLM.
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- Hohenwarter, M. & Preiner, J. (2007). Incorporating GeoGebra into teaching mathematics at the college level. *Proceedings of International Conference for Technology in Collegiate Mathematics (ICTCM)*. Boston, USA.
- Richard, P.R., Fortuny, J.M., Hohenwarter, M., & Gagnon, M. (2007). geogebraTUTOR: une nouvelle approche pour la recherche sur l'apprentissage compétentiel et instrumenté de la géométrie à l'école secondaire. *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare & Higher Education (E-Learn 2007) of the Association for the Advancement of Computing in Education*. Québec, Canada.
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Grant Application Referees

Please give the name and contact details of one referee. The referee should be able to support your application and will be able to inform us if you have some knowledge in this area and think that you will be able to lead and complete the study.

Referee Name: Dr Christopher J. Sangwin
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