

UCET/AACTE Travel Scholarship

Report on Visit to Clarion University of Pennsylvania

July/August 2003

Dr Patricia T Eaton
Stranmillis University College
Belfast

Contents	Page
1. Introduction	2
2. Background	2
3. Aims	2
4. The Clarion FIPSE Project	3
5. Methodology	5
6. Findings	5
6.1 Observations of the Course	
6.2 Interviews with teachers	
6.3 Meetings with Other Professionals	
6.4 A Two-way Process – My Presentation	
7. Conclusion	6
8. Suggestions for UCET/AACTE - The 'Added Value' Dimension	7
9. Personal Reflections and Thanks	8
10. References	8

1. Introduction

This report summarises the findings from my visit to Clarion University of Pennsylvania in July/August 2003, made possible by the generous travel scholarship awarded by the Universities Council for the Education of Teachers and the American Association of Colleges for Teacher Education (UCET/AACTE). I travelled to Clarion to see in action their graduate programme for secondary mathematics teachers.

2. Background

The innovative approach of the programme in Clarion, described in detail below, combining the expertise of three groups of professionals, namely mathematicians, mathematics educators and practising teachers, initially attracted me to the programme. It was my intention to visit the university to experience the graduate courses offered and analyse how the synthesis of the three types of specialists worked in practice. As my own career has combined elements of each of these areas, it was exciting to see how they could be successfully combined in a single programme. Of particular interest was the contribution of practising mathematicians, as my experience in the UK suggests that mathematics educators and mathematicians rarely cooperate in such a formal manner in education courses.

The place of continuing professional development (CPD) for teachers has been to the forefront in several high profile mathematics reports recently, both in the UK and in the USA. The Advisory Committee on Mathematics Education (ACME) in the UK chose to highlight this topic recently in its first report [1]. It draws attention to the *'government recognised urgent need to improve the mathematical skills of the general population'* and suggests that *'one of the most effective ways... to raise the quality of mathematical provision in schools would be to expand substantially CPD for teachers of mathematics'*. Among its main recommendations is the suggestion that *'CPD for teachers of mathematics should contain an element of broadening and deepening of mathematical knowledge'* as well as *'a comparison of varied methods of teaching'*. The programme in Clarion seemed to be meeting all of these demands and therefore it was exciting to visit this programme at a time of heightened interest in CPD in the UK. It is also clear however that the concern about the quality of mathematics teaching at this current time is not confined to the UK and has been identified in the US too as the US Secretary for Education made clear in a speech on the Mathematics and Science Initiative in February of 2003 [2] when it was stated that *'advances in technology and productivity...depend on all students learning more mathematics and on increasing the number of students who expand their mathematical knowledge beyond algebra'*.

3. Aims

This scholarship enabled me to travel to Clarion to meet the following stated aims of my project:

- To experience an innovative approach to mathematics education with a view to implementing some of the broader aims in my own courses and disseminating some of the approaches to my colleagues
- To meet with participants on the course and see the effect that this programme is having on classroom teaching
- To analyse the research underpinning the programme
- To share with my US colleagues my own experiences of mathematics education in the UK

My long-term aim was to initiate a joint research project with Dr. Carbone who was my contact in Clarion and one of the founders of the particular project I was visiting.

4. The Clarion FIPSE Project

The information in this section is mainly taken from the grant proposal prepared by Carbone, R. E., and Beal, J. made to the Fund for the Improvement of Post Secondary Education for the Partnership in Preparing Master Mathematics Teachers program[3].

Clarion University has received a grant from the US Department of Education, Fund for Improvement of Postsecondary Education (FIPSE), to develop a new graduate program for secondary mathematics teachers. This grant, in the amount of \$312,838, provides support for the development of new graduate level courses for high school mathematics teachers by bringing together teams of mathematicians, mathematics educators, and experienced secondary mathematics teachers. The authors of the grant, Jon Beal, Ph. D., and Elaine Carbone, Ed. D., serve as project directors of the grant. During the three years of the grant, new courses will be developed that integrate mathematical content and pedagogy to provide a well rounded degree program.

The objectives of the graduate program are to provide teachers with a deeper understanding of mathematics, to increase teachers' knowledge of current research in mathematics teaching and learning, to improve the quality of secondary mathematics teaching, and to ultimately improve student learning. This project, Partnership in Preparing Master Mathematics Teachers, will disseminate materials to partner institutions of higher education to replicate these innovative graduate courses.

Those individuals designing the program have disjoint, but similar expertise that together aid in closing gaps in the knowledge of teaching secondary mathematics. Outstanding practicing secondary teachers, mathematics educators, and mathematicians will form collaborative teams to develop these courses. Such a cooperative effort has been recommended in the recent draft from the Conference Board of the Mathematical Sciences (CBMS) in the Mathematics Education of Teachers Project [4]. By utilizing this team approach to the development of the graduate program, this project ensures that:

- the mathematical content courses will model best practices of mathematics teaching and learning
- the ideas and theories of the mathematical education courses will be tied to specific mathematical topics and issues from the secondary mathematics curriculum
- changes in secondary mathematics teachers' practices will occur by involving those teachers who are ultimately responsible for this change in the design, implementation, and evaluation of this program, and by utilizing classroom implementation as a requirement of several of the graduate courses.

The Master's degree program is unique in that it emphasises the reform methods of pedagogy through the themes of problem solving, technology, quantitative reasoning, applications through modelling, and the historical development of mathematics throughout the secondary curriculum. While emphasising these identified reform themes of pedagogy, the program revisits the entire secondary mathematics curriculum from an advanced perspective with an emphasis on a deeper understanding of the content of secondary mathematics. The problem of the present 'mile wide and inch deep' secondary mathematics curriculum (TIMSS, 1997) [5] is addressed by specific courses spanning the entire secondary curriculum where students develop a deeper understanding of mathematics within the reform perspective.

The program began during the Summer of 2001 with the first two courses being offered and in each subsequent summer a further 2 courses were offered. All the courses are detailed below.

Teaching Secondary Mathematics

The teaching secondary mathematics course provides teachers with knowledge of current research in mathematics teaching and learning and rich examples of actual reform teaching practices. The course will integrate examples from the themes of problem solving, technology, quantitative reasoning, applications, and historical development with the high school content areas of algebra/number theory, geometry/trigonometry, analysis, and discrete mathematics. The course will also discuss recently published materials relating to educational reform issues.

Algebra/Number Theory for Secondary Teachers

The main philosophy of the course is that improving a teacher's understanding and appreciation of their subject will improve their teaching. From this philosophy come the main goals for the course: to increase high school teachers' understanding of algebra and number theory; to increase high school teachers' aesthetic appreciation of algebra and number theory; to give high school teachers experience in reading theoretic mathematics; to provide high school teachers with a collection of activities they can use in their own classrooms. These activities should focus on algebraic and number theoretic concepts.

Topics in Geometry and Trigonometry

This course will, with extensive use of Geometer's Sketchpad and other software: visit axiom systems; review the core theorems of high school geometry; consider advanced topics in Euclidean Geometry; explore non-Euclidean geometries; examine area and transformations; and investigate trigonometry. Students will present a relatively new geometric topic.

Research in Mathematics Teaching and Learning

In this course, students will investigate the research in mathematics teaching and learning that has been conducted in the last century, and particularly in the last three decades. This research stems from two sources, namely, from mathematics itself and from psychology. Through this investigation, students will become more aware of critical issues within the field of mathematics education. Various areas will be considered, including teachers' knowledge and beliefs, students' learning in number theory, rational numbers, algebra, and geometry, technology in mathematics education, and issues of affect and gender.

Pre-Algebra for Teachers

This course will familiarize the experienced teacher with the teaching of elementary and Pre-Algebra concepts through the suggestions from the National Council of Teachers of Mathematics Algebra Standards for grades six through eight. These include: understanding patterns, relations and functions; using mathematical models to represent and understand quantitative relationships; representing and analysing mathematical situations and structures using algebraic symbols; and analysing change in various contexts. Connections will be made to the Pennsylvania Academic Standards for Mathematics. Technology will also be incorporated in the course. This course includes two fall follow-up sessions.

Applications and Mathematical Modelling for Teachers

This course will cover applications and methods of mathematical modelling by giving students experience in solving real world problems. Students will construct mathematical representations for these problems using statistical data, algebra, functions, geometry, and calculus. They will use technology such as spreadsheets, graphing calculators, and mathematical software to aid the modelling process. Particular attention will be paid to those applications and models that are closely related to the secondary mathematics curriculum.

5. Methodology

I spent a considerable amount of time before I left for the USA studying the program material available on the college website including the aims and objectives of the courses and their structure and design. I then spent one week on site and attended the final week of the last course listed above, that is, the course on applications and mathematical modelling for teachers. I also interviewed two of the teachers taking part in this course and gained insight into the whole programme as these two teachers had taken part in all six of the courses in the program so far. I had the opportunity to talk with the academics running the program and meet representatives from the education and the mathematics departments as well as mathematics educators to learn about the integration of all these areas into a coherent and successful program. I also availed of the opportunity to meet some teachers from the local area and discuss broader issues in mathematics education.

6. Findings

6.1 Observations of the course

There were six high school mathematics teachers taking the course that I attended, taught by Dr Karen Bollinger from Clarion University. The class had been examining several mathematical modelling scenarios and were completing a number of short assignments as well as preparing for their final summative presentation of a self-generated project demonstrating the mathematical procedures that they had practised during the course. The students had been reading research papers on this particular area of mathematics and were encouraged to see their application in a classroom context. There was a very good mix of teaching styles which in itself was a valuable lesson for the students in modelling the successful synthesis of teaching methods in a mathematics classroom. Lively discussion followed by exposition, reading of articles and practical ICT sessions gave the students a varied diet and was far removed from the traditional didactic approach associated with mathematics. Such an experience in their own learning can only have a beneficial effect on the teachers and several commented throughout about their intentions to try out some of the tasks with their own classes when they returned to school.

I was particularly impressed with the teachers' willingness to engage with both complex discussions on the nature of mathematics and to grapple with advanced mathematics when looking at, for example, transforming graphs.

A useful feature of the course was the professional journal in which the teachers recorded their progress throughout the program, thus encouraging the reflective evaluative practise that lies at the heart of all successful teaching.

The highlight of the week in the class was the opportunity to attend the final presentations of the students and listen to them explain how they had put all that they had learned in the last few weeks together to apply it to a real life problem of their own choosing.

6.2 Interviews with teachers

In an interview with some of the teachers who had experienced all six courses in the program I asked about the benefits that they had noticed in their own classrooms. They both remarked that the main benefit was their improved self-confidence. In taking mathematics to a level more advanced than that actually required in the high school classroom they felt that they could better guide their own students and that they had a clearer overall picture of the mathematics that they were teaching. They now had the confidence to try out different teaching methods and were not afraid to stray from the traditional drill and practice methods. Some commented that in looking at research papers and ideas from around the world they were confident that these innovative methods were research backed and were not just purely experimental. There were some positive comments about the journal, in particular its role in encouraging reflective teaching. The opportunity to engage in debate with other teachers and with experienced professionals was also seen as a major benefit of the program.

As well as this particular program we also had a wide-ranging discussion on mathematics teaching and exchanged our views on issues such as calculators in the classroom, examination styles and the shortage of mathematics teachers.

6.3 Meetings with other professionals

In discussions with other staff I found a number of common themes emerging, such as:

- the world-wide shortage of suitably qualified mathematics teachers
- examination styles, e.g. multiple choice versus problem solving papers
- the level of high level mathematics in initial teacher training courses
- the timing of school placement in initial teacher training courses
- the organisation of CPD for teachers

I hope to follow up some of these themes in research papers produced in light of this visit.

6.4 A Two-way Process – My Presentation

On the last day of my visit I had the opportunity to give a presentation entitled 'A Northern Irish Perspective on Education' to an audience of academics and teachers. This event was organised by the West Shortway Chapter of Phi Delta Kappa International- The Professional Association for Educators in collaboration with several departments at Clarion University. This was a chance for me to highlight the similarities and differences between our two systems of education and to engage in a long and interesting question and answer session.

7. Conclusion

In terms of meeting my stated aims I feel that the visit was extremely successful and in fact my colleagues and I in both institutions will gain much more than had been hoped for from the exchange of ideas and the projects initiated.

As someone who is training mathematics teachers of the future, it was very interesting for me to see how such an academic programme can have a powerful effect on classroom practice. Also, as I reflect on the current desire in academia to produce research-led courses, I appreciated the opportunity to learn about how education research can be made relevant to teachers, as it is too often seen as remote from their day-to-day experiences.

In general I found the program of CPD developed at Clarion to be extremely effective and of a very high quality and would make the following recommendations for CPD in Northern Ireland:

- At the moment most CPD in Northern Ireland is of a general nature and does not necessarily focus on the subject specialism of the teacher. In line with the ACME [1] recommendations and in light of the success of the scheme in Clarion, CPD for mathematics teachers should contain elements of high-level mathematics combined with teaching methodologies and classroom practice.
- CPD courses should be designed more collaboratively and involve professionals from academic mathematics, from mathematics education and experienced practitioners from the profession itself.
- There should be a broad range of CPD courses available for teachers to choose from so that they can target areas in which they are specifically interested. However a certain proportion of CPD time should be spent on subject specific tasks.
- As is the case in the USA, teachers should be able to gain credit for their CPD courses that would be recognised in obtaining further degrees.

8. Suggestions for UCET/AACTE – The 'Added Value' Dimension

1. In what way did the visit contribute to the research for you personally?

While modern technology allows research to take place across continents in a way that has hitherto been unimaginable, nothing can replace the insight into a course that actually attending it provides and the opportunity to meet with so many people in person that just would not happen without a visit to the relevant institution. The research produced as a result of this visit will be greatly enhanced by my visit to Clarion University.

2. Did the visit contribute in any way to your HEI?

I am sure that my own courses will benefit greatly from my visit and that my students will have a broader learning experience as I implement some of the strategies that I saw in action in Clarion. I also intend to share my experiences with my colleagues formally and informally in the next few months.

3. Was anything gained by the receiving institution in the USA?

I hope that my talk was a formal opportunity for colleagues in the USA to gain a different perspective on teacher education and provided a forum for exchanging ideas. I also hope that the more informal discussions throughout the week were useful to those who participated.

4. Do you expect any lasting relationship between the two or more institutions?

Dr Carbone and I hope to write up two research papers on the theme of continuing professional development of mathematics teachers and so will continue to collaborate for the foreseeable future. We are also looking for funding to finance a return visit for Dr Carbone and perhaps some student mobility between the two colleges

5. Have you any other comments concerning the UK-USA link?

The links encouraged by this scholarship are very valuable to both countries. Our education systems are so similar in many ways and we have a lot to learn from one another in our approaches to common problems and situations. In exploring the differences we are also challenged to think about our own education systems and to re-assess current provision. I would encourage anyone involved in education who is eligible for this scholarship to apply and avail themselves of the opportunity to develop their career and hopefully contribute positively to teacher education in both countries.

Suggestions

Reading the experiences of previous applicants was greatly encouraging in applying for this scholarship. Virtually all of them have identified the desire to obtain further funding for their projects and it would be useful for UCET/AACTE to publicise how the projects proceeded after the scholarship so that the scholarship is seen as the start of a process of collaboration rather than an aim in itself.

9. Personal Reflections and Thanks

This was a wonderful opportunity to spend discussing and analysing mathematics education and to experience a successful program of CPD as well as to share some of my experiences with colleagues in the USA.

My thanks go to UCET/AACTE for their generous sponsorship of my visit and to the staff and students of Clarion University, Pennsylvania for their warm welcome and hospitality. A particular thanks is due to Dr Elaine Carbone and her family for their hosting of my visit and their time and patience in answering all my questions and dealing with the practical issues. A particular mention is also due to Dr Karen Bollinger for allowing me to observe and participate in her course and to her students for sharing so openly with me.

10. References

[1] Advisory Committee on Teacher Education (ACME) (2002) Continuing Professional Development for Mathematics Teachers.

[2] US Department of Education (2003) The Secretary's Mathematics and Science Initiative, Report of Mathematics Summit.

[3] Carbone, R. E., and Beal, J. (2000) Grant Proposal for a Partnership in Preparing Master Mathematics Teachers. Fund for the Improvement of Post-Secondary Education.

[4] The Conference Board of the Mathematical Sciences (2001) The Mathematical Education of Teachers, Issues in Mathematics Education Vol. II, American Mathematical Society.

[5] National Center for Education Statistics (1997) Third International Mathematics and Science Study.