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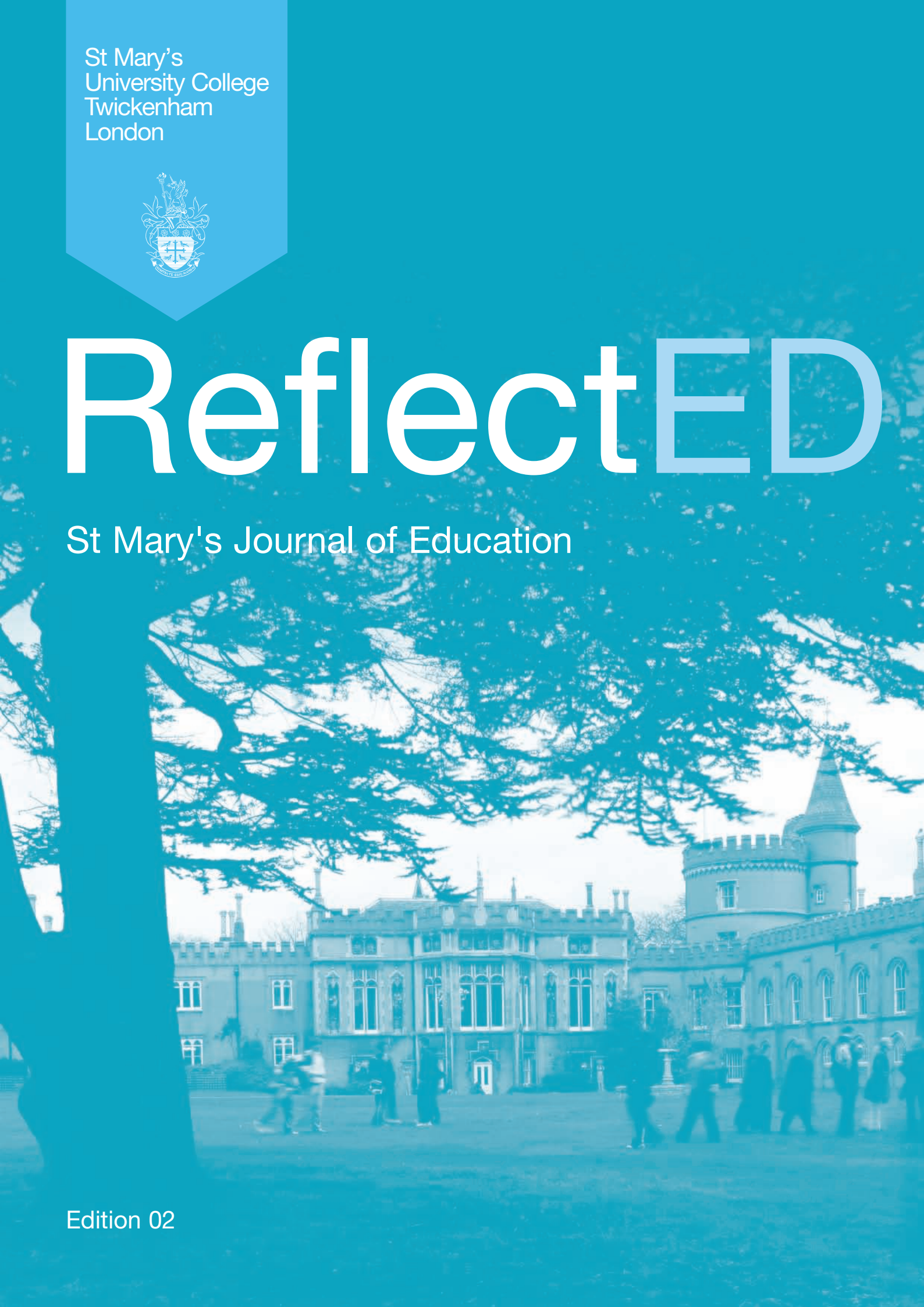
ReflectED

St Mary's Journal of Education



Edition 02

ReflectEd
St Mary's Journal of Education

Aims and Scope
ReflectEd provides a forum for the publication of interdisciplinary articles that celebrate the challenging and changing nature of educational research and practice. It is published by the School of Education to encourage, celebrate and disseminate research, scholarly activity, and exciting pedagogical practice that is in keeping with our mission. This mission is to advance education through continuing reflective practice and professional development in diverse schools.

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Editorial: Learning Is The Heartbeat Of Education

Dr Christine Edwards-Leis
Editor

Writing is a reflective past-time. It challenges us to remove ourselves from the bustle of everyday life and to move into a quiet place where thoughts have room to emerge, evolve and consolidate themselves into a narrative much like the threads of a tapestry coming together to form a picture. This edition of ReflectEd: St Mary's Journal of Education is a new beginning and, as such, demands some reflection in order to create an appropriate introduction. This introduction has emerged from my ponderings on the journal's journey over the last eighteen months. In November 2011, St Mary's Education Research Committee decided to continue to publish ReflectEd and we looked once again at our institution's mission and values to guide the configuration of the journal. St Mary's works hard to provide research-enriched teaching for the preparation of its students to lead flourishing lives and it values such things as respect, fairness and excellence. We hoped that ReflectEd would become a vehicle for partnership between students, teachers, and academic staff and exhibit those values. We believe that this has been achieved and this first 'new' edition demonstrates the importance such a publication has for forging bonds between the different stakeholders in education. As the edition came together, I read each article and reflected on matters that might interest all of those who read the journal; Dewey (1938) recognised education as an important social issue evidenced by the practical and theoretical struggles that populate its broad arena. What I found through my ponderings and what I hope you will find in this edition is a simple thread: learning is the heartbeat of education.

This edition explores learning in different contexts and in different parts of the world. We are delighted to include articles from students and teachers ensuring that ReflectEd provides a forum for valued research and excellent practice. Sanna Kovanen's article about theme working in Design and Technology prompts us to explore the possibility of children learning to design and create in a supported and creative learning space. While set in Finland the process discussed is applicable to classrooms in all parts of the world. The article celebrates what Giroux (1997) would say is decentering the classroom by moving from a teaching-centred to a student-centred environment.

The focus on what the learner can achieve in an innovative learning environment is continued in the article written by three teachers in Australia. Cathy Hyde, Susan Ekeberg and Scott Burns share their learning journeys through the implementation of a 1:1 laptop programme. Their story mirrors what Freire (1998:33) described as a "context of true learning" where the pupils are "engaged in a continuous transformation through which they become authentic subjects of the construction and reconstruction of what is being taught, side by side with the teacher, who is equally on the same process". It is an exciting adventure and the personal reflections included at the end of the article enable us to glimpse both the enormous learning leap that the teachers have made and the courage that was enacted to take the first step.

Articles from undergraduate and post-graduate students from St Mary's are in this edition as well. Samantha Taylor, a third-year Bachelor of Arts: Initial Teacher Education student, explores the value of discussion in the teaching of mathematics. She probes the advantages and issues about enabling pupils to talk about mathematics and reinforces what Myers and Beringer (2010) suggest is more than simply learning a new skill set. They believe that the identity of the student is often overlooked and it is through collaboration that the necessity to be self-determining and motivated becomes part of what is learned (Myers & Beringer, 2010). Another mathematics focus is evident in the article by Nicole Mather that investigates the issues around girls studying mathematics. It is clear that Dewey's (1938) idea of collateral learning is an important issue often overlooked in the stress of modern classrooms where meeting the needs of a culture of testing predominates.

Bernie Simcox writes about education for sustainable development in secondary schools with a view to offering valuable suggestions for future practice. Curriculum and its implementation is an evolutionary and political process. There has been considerable public focus on what is learned evidenced by the release of draft curricula in the UK. Barrow (1976) discussed Plato's view of a liberal education and suggested that even he would concede that in today's world absolute knowledge is unattainable. In discussing an ideal education Barrow (1976) proposed that this eminent Greek scholar would support an approach that enabled learners to develop both their understanding of whatever forms of knowledge were evident at the time and an appreciation of the philosophical form of knowledge itself. How pupils will 'act upon' what they learn in the future is of interest to all of us given the possibility for rapid global change in economic wellbeing, social interdependence and environmental concerns and constraints.

The thread that winds its way through this edition reflects Dewey's (1938:25) "organic connection between education and personal experience" and how the surroundings provided for the learner should be "conducive to having experiences that lead to growth" (p.40). This edition contains the celebration of the learner rather than what is learned. A poem called The Minister for Exams by Brian Patten (1996) illustrates how a focus on testing through exams and the need to pass them does not measure the contribution of what a child (or the adult they will become) can make to our society if we deny the existence of the imagination. Patten (1996) shares his exam responses and how on one such instrument he wrote about "the exact weight of an elephant's dream" and that the moon has "the flavour of starlight". Patten's desire to be a writer was potentially thwarted by a career counsellor who said that because he had failed to pass exams, he couldn't be a writer.

His response was to write two test questions himself:

- "Question 1: How large is a child's imagination?
- Question 2: How shallow is the soul of the Minister for Exams?" (Patten, 1996)

Freire (1972:44) discussed co-intentional education where teachers and their pupils were co-intent on reality and "both subjects, not only in the task of unveiling that reality … but in the task of recreating that knowledge". He suggested this was done through "common reflection and action" (Freire, 1972:44). It would seem, therefore, that teacher as learner necessitates a different view of Giroux's (1997) student-centred environment. The journey of learning is a shared one and the articles in this edition demonstrate the "emancipatory potential of knowledge" (Myers & Beringer, 2010: 54) not just being relevant to the pupils that we teach but the colleagues with whom we share a profession. Learning, in this broad and 'real' sense then takes its place quite firmly at the heart of education.

This edition of ReflectEd: St Mary's Journal of Education re-launches an initiative started in 2011 when the first edition was published under the editorial guidance of Dr Lorna Goodwin. Many on that first editorial board including Anna Lise Gordon, Dr Maria James, Dr Jane Renowden and Dr Linda Saunders, have continued to contribute their professional services to review submitted articles. We also welcome several new members to the editorial team from St Mary's including Professor Lesley Haig, Dr John Lydon (School of Theology, Philosophy, and History), Mary Mihovilovic and Alex Sinclair (School of Education). We have engaged the services of reviewers from further afield including Steve Keirl, Goldsmiths, University of London and international colleagues Sonja Virtanen, University of Jyväskylä, Finland and Dr Debbie Price, University of South Australia, Australia. The members of the team have experience in different disciplines and sectors of education thereby providing the wealth of talent and expertise necessary to take the journal's journey forward. We look forward to bringing you articles from students, academics and practitioners that will inform you of current research and best practice. We hope to challenge you to think more deeply and broadly about what learning means in your classroom, and to, above all, share our learning journeys.

Reference List

Barrow, R. (1976) *Plato and education*. London: Routledge & Kegan Paul

Dewey, J. (1938) *Experience and education*, NY: McMillan

Freire, P. (1972) *Pedagogy of the oppressed*, London: Penguin Books

Freire, P. (1998) *Pedagogy of freedom: Ethics, democracy and civic courage*, Maryland US: Rowman & Littlefield Pub Inc.

Giroux, H.A. (1997) *Pedagogy and the politics of hope: Theory, culture, and schooling*. Boulder, CO: Westview

Myers, O.E. & Beringer, A. (2010) *Sustainability in higher education: Psychological research for effective pedagogy*. Canadian Journal of Higher Education, 40(2), pp.51-77

Patten, B. (1996) *Armada*, London: Flamingo (Harper Collins)

Theme Working In Technology Education

Sanna Kovanen
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Introduction

This article discusses how technology education taught with a teacher-centered method does not benefit the pupils in today's world. Modern society is constantly changing and by teaching pupils always to copy already existing models, whether they are concrete objects or a greater ideology, we raise pupils to be unprepared adults who are incapable of changing for the more demanding and variable world.

I will argue that a theme-working method is a more relevant teaching method now and especially in the future in technology education by explaining how this teaching method improves creativity and problem-solving skills. These are just two of the many qualities appreciated in modern society. Since this method is rather new I will also concretize it by demonstrating an example of the project that can be made with the theme-working method. That method is a working solution to develop the whole technical education and also pupils' skills and qualities for the more demanding future.

About Theme Working Method In Technical Craft

Technical craft (technology education) and especially woodworking has a long history and tradition in the Finnish education system. Since 1866, when Uno Cygnaeus launched Finland's national education system, only boys have been practicing handicrafts skills in technical craft lessons (Kananoja, 2010: 45). Learning the right techniques by producing an exact copy of the teacher's model has been at the expense of practicing designing skills such as aesthetical skills, creativity and problem solving. Modern society is developing at a rapid pace and demands for certain qualities and skills, such as creativity and problem solving and also the ability to be innovative, are increasing (Rasinen, Virtanen, Endepohls-Ulpe, Ikonen, Ebach, & Stahl-von Zabern, 2009: 378). These skills and other important knowledge and understanding are needed in everyday-life and can be taught in technology education lessons in schools (Leponiemi, Virtanen & Rasinen, 2012: 460–461). Young children can also be naturally creative but without education that fosters that quality, the naturally existing creativity is a lost capacity (Leahy, 2012: 282). Traditional teacher-centered teaching methodology has served well in the past but now it is time to update it to better respond to the present and future demands of society.

In the traditional chalk and talk method in technical crafts, a teacher has a ready-made model of the project to be made. Pupils then copy the model as well as they can under the teacher's supervision. They might be allowed to fulfill themselves by painting their products in different colors. This working method leaves very little space for the pupils to design products themselves. It can teach the techniques mentioned in the National Core Curriculum (National Core Curriculum for Basic Education, 2004: 238–244) by forcing pupils to mechanically copy a design that is not their own. This does not encourage children to test and value their own ideas and designs and, in the worst case scenario, child after child ends up copying the same kind of soup ladle year after year. Here only the product itself is valued: the learning that happens during the manufacturing process is easily forgotten (Marttinen & Paukkunen, 2013: 48).

The theme-working method means a wider product-associated framework, a pedagogical ideology, which is used to motivate, plan, execute and assess the work to be done in technology education (Huovila & Rautio, 2007: 41). As a working method, the theme-working method involves pupils more than does the widely used teacher-centered method. In the theme-working method teachers set some outlines for the project and then pupils are quite free to design and make their products. Of course, the age of the pupils, material limitations, restrictions for the use of different machines, time and the national core curriculum sets some natural guidelines for the possible projects.

The starting point for the project should somehow be related to the lives of the pupils and it could be an experience, a problem that needs to be solved, a demand or simply a material to be used. If the product to be made is put into a wider context and appropriate guidance throughout the process is available, it nurtures pupils' confidence (Winn & Banks, 2012: 494). The fundamental idea in this kind of method is not the product but the process and the skills and knowledge it develops. Techniques and materials used by pupils in these projects are means for solving oncoming problems when working towards certain goals (Marttinen & Paukkunen, 2013: 46).

When talking about technical work the issue of safety is always present. According to safety instructions for crafts (Aadeli, Aalto, Myllymäki, Pekkarinen, Poutala, Rinta-Rahko, & Suurnakki, 2011: 22–23), a good learning atmosphere, peacefulness and a positive attitude towards the subject promotes work safety. When working with passion and desire, pupils feel that the solution to problems occurring in the project can be solved by their own innovative ideas, which can increase the motivation towards technology education (Marttinen & Paukkunen, 2013: 50). Saari (2013) studied elementary school pupils' thoughts about the theme-working method and the results showed that pupils appreciated the freedom to design, plan and work. They were also genuinely excited

about the chance to invent something completely new (Saari, 2013: 44–48). By paying attention to creativity, technology education might seem more interesting to girls as well (Virtanen & Ikonen, 2011: 398). This suggests that taking children's own opinions and designs into account when planning technical craft projects enhances positive attitudes and the motivation towards technology education. This strongly defends the idea that the theme-working method is the right teaching method for today's schools.

An Example Of Theme-Working In Technical Craft

This plan for the theme-working method is designed for fifth or sixth graders, 11 to 12-year-olds, and it integrates arts and woodwork. It can be executed as an individual project or as a pair or group project. The combining of different subjects is also mentioned in the chapter on technical education in the Finnish National Core Curricula for Basic Education (NCCBE, 2004: 238–244). The main idea is for pupils to design and make some kind of wooden game in which they combine arts (drawing, painting) and woodwork. The aims for this work are divided according to different sections of a pedagogical framework for planning called "Nelikenttä" (Huovila & Rautio, 2007). The first section of Nelikenttä discusses the "Knowledge and skills of technology" and it includes materials, techniques and tools. In this project the pupils will get familiar with different types of wood, tools, paints and techniques and they need to choose the proper ones to execute their projects. While making the wooden game the pupils get the chance to practice different techniques and the use of machines needed to complete the project. The aim for "Designing skills" is for pupils to design the game themselves and to design the work plan. In this project the challenge might be how to combine arts and wood into a game. At the same time this characteristic allows pupils to really focus on designing and to practice problem solving when trying to make a real game.

The stated aims in the "Working skills" section of the Nelikenttä (Huovila & Rautio, 2007), is to develop pupils' ways of working. When working with this project the pupils will practice perseverance, both independent, group or paired working, planning the next steps while working and working towards the goal (a playable game) they have set. Working safely and responsible behaviour are also very important parts of "Working skills". The last section covers the "Educational skills". Here the aim is for pupils to understand the quality of their work and the material they have used. This also encourages pupils to learn about sustainable development and environmental issues and also show responsible actions in their work. The most important goal here is to build pupils' self confidence and the ability to evaluate products they have made themselves.

Project Outlines And Methods Of Working

The teacher sets the outlines for this project so it would not expand uncontrollably and wood itself, as the material in this project, will guide the planning of the game. The materials available in this project are plywood, MDF, dowels and lath, different colour paints, screws, nails and other small accessories. The machines that can be used are the electric drill, screwdriver, jigsaw and the drilling machine. The techniques that can be used are drilling, sawing, gluing, painting, and using a screwdriver and sand paper amongst other things.

At the beginning of this project the teacher may show pictures of different kinds of wooden games as shown in Figure 1 and introduce the machines that can be used when making the game. From this point on it is up to pupils' own imagination and designing what kind of game he or she will plan and produce. Naturally the teacher will guide the designing process by monitoring that the pupils do not choose, for example, too difficult or time-consuming game for them to produce.

Figure 1. Different wooden games

After the motivational pictures of wooden games pupils are to start designing their game. First they can plan the game by themselves and then they are going to work in groups so that other pupils can suggest some improvements to their designs. After each pupil's final design the teacher is responsible for checking that ideas are realizable and if not, then guide the pupils to change the idea.

When everyone's plans are ready the pupils will start working with their projects. Since the games probably are very different from each other, pupils will begin to work independently. Some might start drawing a picture onto plywood; some might start building a box for a labyrinth. At this point the teacher needs to show everyone how the machines work. Naturally the teacher has a responsibility to advise pupils later on as well, but for general knowledge and safety reasons it is important to teach the principles of the machine usage to everyone.

After the instructions and practice with the machines the pupils are free to continue to work with their games. Since the games the pupils are making differ from each other, they are working independently a lot. The teacher must instruct the pupils to ask for advice at anytime they want to use machines or when they feel they do not know what to do. Pupils will not finish their projects at the same time so the teacher needs to have some other tasks planned for those who are faster than the others. They might be able to make something else related to this theme. In this project it is quite easy to differentiate according to the skills or abilities of a pupil. The pupils with lower skills will still be able to make a game and feel good about themselves. At the same time the pupil with high skills will be able to fulfill themselves by making a game that is more difficult to produce.

Evaluation

One general problem with the theme-working method has been related to assessment. Traditionally the teacher has evaluated pupils' work by focusing only on their products and their qualities. When done in a formative way, the assessment will help pupils' learning processes and the pupil will have an active role in it. A model of designing in technology education was developed to help teachers to assess the design processes of pupils; it was intended to help pupils to develop their metacognitive skills and practice self-assessment. The six stages, with suitable criteria at each stage, guide teachers to assess pupils' development of designing skills (Leponiemi, Virtanen & Rasinen, 2012: 462–464). As the project described in this paper was planned according to Nelikenttä's (Huovila & Rautio, 2007) different sections it should also be assessed according to same principles. That is the only way the assessment is relevant and will genuinely be useful for the pupils. There is an example of an evaluation sheet to be used when assessing this project in Appendix One.

Conclusion

This article has discussed how the teacher-centered teaching method in technology education does not apply anymore to the needs of modern society. The demands to succeed in life are rapidly increasing and education should guarantee the knowledge and skills needed in future. I have explained the basic principles of the theme-working method and also described why it would better prepare the pupils for working life than the old chalk-and-talk method. In order to concretize this method I also presented an example of the theme-working method and suggested implementing it with wood materials. For this theme-working method to take the place of the teacher-centered teaching method, teachers need to be courageous enough to give more responsibility to pupils. This action may seem difficult to take at first but I genuinely believe that using the theme-working method in technology education gives more to both the pupils and the teachers.

Reference List

Aadeli, S., Aalto, R., Myllymäki, H., Pekkarinen, J., Poutala, M., Rinta-Rahko, A. & Suurnakki, T. (2011) Käsityön työturvallisuusopas - Perusopetuksen teknisen työn ja tekstiilityön opetukseen. Helsinki: opetushallitus.

Huovila, R. & Rautio, R. (2007) Nelikenttä käsityönopetuksen käytännön työvälineenä. Jyväskylän yliopisto.

Kananoja, T. (2010) Finnish technological education; handicrafts and technology education from 1866 up to now. In A. Rasinen & T. Rissanen (Eds.) In the Spirit of Uno Cygnaeus – Pedagogical Questions of Today and Tomorrow. 200th Anniversary of the Birth of Uno Cygnaeus. Symposium 12th-13th October 2010. Jyväskylä. 45-59.

Leahy, K. (2012) Are we educating to promote students' creative capacities?: A study in Technology Education in Ireland. In T. Ginner, J. Hallström & M. Hultén (Eds.) Technology Education in the 21st Century. The PATT 26 Conference. Stockholm. 282–292.

Leponiemi, T., Virtanen, S. & Rasinen, A. (2012) Design and assessment in technology education – case: the "Birdhouse Band" project. In T. Ginner, J. Hallström & M. Hultén (Eds.) Technology Education in the 21st Century. The PATT 26 Conference. Stockholm. 460–467.

Marttinen, R. & Paukkunen, J. (2013) "Kuularata – Hauskempi kuin löylykauha" Ongelmanratkaisuprojektin soveltuvuus teknologiakasvatukseen perusopetuksessa. Kasvatustieteiden pro gradu- tutkielma. Opettajankoulutuslaitos. Jyväskylän yliopisto National Core Curriculum for Basic Education (2004) Finnish National Board of Education. Vammala.

Rasinen, A., Virtanen, S., Endepohls-Ulpe, M., Ikonen, P., Ebach, J. & Stahl-von Zabern, J. (2009) Technology education for children in primary schools in Finland and Germany: different school systems, similar problems and how to overcome them. International Journal of Technology and Design Education 19, 368-379.

Saari, T. (2013) Alakoululaisten ja opettajien ajatuksia aihepiirityöskentelyn käytöstä teknisen työn opetuksessa. Kasvatustieteiden pro gradu-tutkielma. Opettajankoulutuslaitos. Jyväskylän yliopisto.

Virtanen, S. & Ikonen, P. (2011) Searching for ways to encourage girls to study technology in primary education. In K. Stables, C. Benson & M. de Vries (Eds.) Perspectives on Learning in Design and Technology Education. The PATT 25 Conference. London. 393-398.

Winn, D. & Banks, F. (2012) CAD and Creativity – A New Pedagogy. In T. Ginner, J. Hallström & M. Hultén (Eds.) Technology Education in the 21st Century. The PATT 26 Conference. Stockholm. 488-495.

Appendix One

Evaluation sheet based on Nelikenttä (Huovila & Rautio 2007)

Knowledge and skills of technology • knowledge about different types of wood • knowledge about techniques needed to make the game • knowledge about the usage of relevant machines	What was good? What needs improvement?
Designing skills • appropriate design for the purpose • aesthetic skills • capability to design a usable product	What was good? What needs improvement?
Working skills • Capability to work independently • Capability to work in groups • Capability to adjust the plan while working if needed • Perseverance • Working towards the goal • Safety issues	What was good? What needs improvement?
Educational skills • Understanding the quality of the material • Valuing one's own product • Understanding the sustainable development and environmental issues • Responsible actions while working • Development of self confidence	What was good? What needs improvement?

The Journey: Introducing a 1:1 laptop programme

Cathy Hyde, Susan Ekeberg and Scott Burns
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Introduction

Let us introduce ourselves and our school. We are three primary school teachers, Susan Ekeberg, Scott Burns and Catherine Hyde, and each of us brings our own experiences and passions to our Year Five Team. Our wonderful school is Saint Mary Mackillop Primary School and it is located in an outer suburb of Brisbane near Moreton Bay. It is a P-7 school with 629 students.

Background Information

Like any new project there is a lot of research that goes into beginning a journey such as ours. In 2010 the school began exploring the concept of a 1:1 laptop programme and soon realised that lots of planning and research into the benefits of such a programme needed to be thoroughly investigated. The School Leadership Team began discussions with Brisbane Catholic Education (BCE) and it was soon established that there would need to be significant investment in infrastructure to ensure the readiness of the school with technology such as a CISCO Wireless Solution.

Investigating and Planning

In 2011 a committee, comprising teachers, the Leadership Team and the school technician, investigated and researched the benefits and challenges of this type of programme. The investigation took the form of thorough reading of relevant documents and also visiting a number of schools that had already implemented similar programmes. As teachers, we understood the importance of providing the students with skills they would need for the 21st Century and we were aware that we would also be beginning to implement the new Australian Curriculum (ACARA, 2011). The Australian Curriculum (ACARA, 2011) acknowledges the importance of ICT as a learning competence in partnership with Design and Technology (the 'Technologies').

Currently there is no published curriculum documentation for ICT competence as a general capability. Rather, its place in the Australian Curriculum (ACARA, 2011) is recognised within each of the four published learning areas of English, Mathematics, Science and History, through embedding in content descriptions and/or achievement standards. As a learning area, work is just beginning on determining ICT's 'conceptual' home and its content (DET, 2009).

Becoming familiar with the new Australian Curriculum (ACARA, 2011) provided the committee with further knowledge of the merits of beginning a 1:1 laptop programme. Central to it are the General Capabilities and ICT is organized into the following five interrelated elements:

- applying social and ethical protocols and practices when using ICT;
- investigating with ICT;
- creating with ICT;
- communicating with ICT; and,
- managing and operating ICT (ACARA, 2011).

A 1:1 device, such as a laptop computer, would not be capable of doing these elements by itself, but by putting this technology in the hands of our students and with the right support, the vision of personalized learning would become possible. Some of the benefits of using a 1:1 programme were attractive and included:

- student **attendance increases** and students are **more motivated and more engaged** (Russell, Bebell & Higgins, 2004);
- students **write more, more often and better** (DET, 2009; Gulek & Demirtas, 2005);
- overall **improvement in test scores** (Gulek & Demirtas, 2005); and,
- students engagement in **critical thinking**, problem-solving, and **higher-order thinking** on a task increased with 1:1 students more willing to address/assess controversy within an assignment (DET, 2009).

The committee visited schools that had successfully implemented a 1:1 computer programme and investigated how they were using these devices to enhance the learning of students. The Information Curriculum Literacy Technology (ICLT) Committee, at Saint Mary Mackillop, set goals for implementation from 2011 to 2013 and had initial discussions with the school board. During the third term of 2011 Susan Ekeberg and her class began a three week trial using Apple MacBooks. At the end of the trial parents, teachers and students were surveyed and after receiving very positive feedback from all participants it was decided that, as a school, we would proceed to introduce a 1:1 laptop programme at Saint Mary Mackillop in Year Five in 2012.

Getting Started

Several parent information evenings were conducted to inform parents of this new, exciting project. Many questions were being asked and needed to be answered including:

- why was the school beginning a 1:1 laptop programme?
- what could they do as parents to help prepare and support their children?
- what would a 1:1 classroom look like?
- why did the school decide to go with Apple?
- how would the laptops be funded? (shared cost between family and school or outright purchase by parents?)
- what would be included in the package such as warranty, cases, and insurance?

These questions were answered over several information sessions and, on the whole, there was a positive response from parents who seemed confident that sufficient research and preparation had been put into the project. Many thought it was 'amazing' that their child would have a laptop to call their own and be able to bring home each night.

The Real Beginning

So that we could proceed in 2012, the three Year Five teachers had to reassure the Leadership Team that we were committed to this exciting journey and that we would work as a team to support one another and the introduction of the programme. At the beginning of 2012, Apple MacBooks were purchased and distributed to the three Year Five classes of 26 students each and so began our Contemporary Learning Project. It was important that everyone involved was on the same page and shared the same vision for this project. The teachers knew that simply adding a digital device, such as a laptop, to the classroom without a fundamental change to our pedagogy would not improve the learning outcomes for the students.

Essential to this project was the importance placed on professional development for teachers at the start of the programme. The Leadership Team and BCE were very supportive and recognized that the focus for staff development needed to include more than technical training. The preparation and development also needed to allow the teachers to empower their students; it was essential to design lessons and units of work that would engage students in a learning community.

During 2012, the Year Five teachers attended five full days of training provided by BCE with other teachers from Catholic schools in Brisbane who were also implementing similar programmes. Danielle Carter, an education officer with BCE, and Natalie Cartwright, from Learning Horizons (a consultancy group), led these professional and informative days. The five days aimed to focus on action research based around pedagogies that impact on student learning according to educational research (Shear, Gallagher & Patel, 2011) and 21st Century skills (Dede, 2009). The professional development investigated ways to implement technology in a 1:1 or technology-rich environment and ensure that the focus is on the use of technology in the learning process, rather that the technology itself.

The Training

The goals of the five days were to:

- enhance pedagogical practices that engage students and improves student learning;
- build a professional learning community;
- create practical ideas to implement in classroom environment; and,
- build reflective practice as way of working.

How The Goals Were Achieved

Before the computers could be fully utilised in the classroom the teachers needed an understanding of 21st Century skills (Dede, 2009) and the development of innovative ideas to achieve these. To begin with teachers examined the findings of research, based around innovative teaching and learning (Shear et.al., 2011).

This research (Shear et.al., 2011) highlighted four significant areas. At the *system level* there needed to be assessment and appraisal aligned with innovative teaching and learning goals. At the *school level*, there needed to be leaders who developed integrated and shared visions of innovation in the school setting. At the *teacher level*, a nurturing climate needed to be established that provided teachers with opportunities to collaboratively design and research innovative teaching. Lastly, at the *student level* students needed rich learning experiences with access to ICT and teaching and learning experiences that provided opportunities to prepare them for their future.

After developing an understanding of the opportunities of what technology provided in education, the teachers led by Natalie Cartwright and Danielle Carter were immersed in a professional learning programme, *21st Century Learning Design* formerly called "LEAP 21" (Shear et.al., 2011). Innovative teaching and learning, according to Shear et.al. (2011), is about providing learning opportunities for students to develop the skills of collaboration, knowledge construction, self-regulation, real-world problem-solving innovation, the use of ICT for learning and skilled communication.

This programme is based on ILT Research and enables teachers to analyse and rate learning activities using provided rubrics (Shear et.al., 2011). Teachers were asked to review sample units of works and evaluate these against the rubrics to find out how successfully they met the criteria within each skill area. This process provided a practical model in which the teachers could design units of work that integrated the 21st Century Skills (Dede, 2009) and provided innovative teaching and learning opportunities for their students.

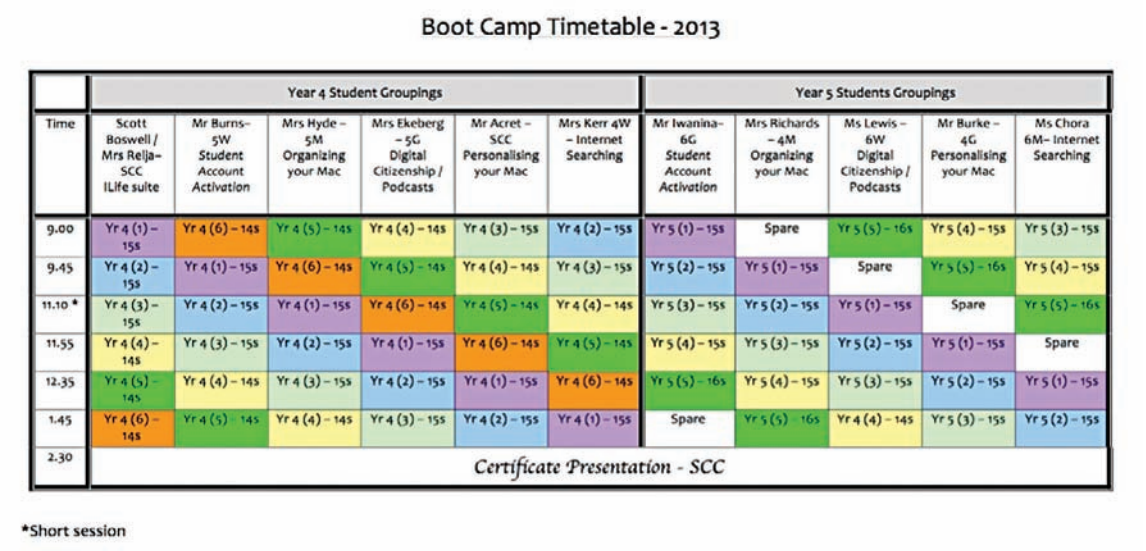
The Assistant Principal at Saint Mary Mackillop joined us on the programme and we all found these days to be informative, challenging and productive. The programme allowed the teachers to become learners of their own teaching practices by studying the impact of their teaching on their students. The professional development days allowed teachers to be engaged in deep conversations about innovative teaching and learning programmes and made real and significant changes to classroom practice. It is essential that for a 1:1 programme to have a chance of success that support from the Leadership Team and professional development are present.

Preparing The Students

When implementing a 1:1 Laptop Programme it would be foolish (and ignorant) to assume that we just handed out the laptops to the students and said, "Go for it!" At the beginning of the year there were very high expectations of the programme and we wanted it all to happen straight away. We had heard about the terrific learning opportunities such devices could provide and we had many ideas of how the classroom would look and feel once the 1:1 laptops were introduced. Perhaps our expectations were a little high to begin with! In the first term both teachers and parents needed to take "baby steps." However, in the beginning, students used the device less regularly and they began with online interactive sites such as '*Mathletics*' (www.mathletics.co.uk) and an introduction to important basic skills such as touch typing courses.

However, the potential of the learning device is much greater than competitive drill sites and practice tutorials. Like any classroom in Term One of a new academic year, the teachers needed to take time setting up rules and routines which were going to set the students up for success for the whole year. Students needed regular teaching around becoming 'digital citizens' who followed cyber safety rules. The learning in this area does not stop just after the introduction of the device: it is something that needs to be continually revisited every week because students forget and can form bad habits. The students also had lessons on how to carry their laptops and rules were established around the care and charging of batteries.

Another important part of the implementation was a 'Boot Camp' Day (*see Figure 2*) before the students finally took their laptops home. This day saw the students rotate through a variety of lessons which would allow them to personalise their laptops and view a snapshot of the potential of their new 'learning tool'.



Boot Camp Timetable - 2013

	Year 4 Student Groupings						Year 5 Students Groupings				
Time	Scott Boswell / Mrs Relja– SCC ILife suite	Mr Burns– 5W Student Account Activation	Mrs Hyde – 5M Organizing your Mac	Mrs Ekeberg – 5G Digital Citizenship / Podcasts	Mr Acret – SCC Personalising your Mac	Mrs Kerr 4W – Internet Searching	Mr Iwanina– 6G Student Account Activation	Mrs Richards – 4M Organizing your Mac	Ms Lewis – 6W Digital Citizenship / Podcasts	Mr Burke – 4G Personalising your Mac	Ms Chora 6M– Internet Searching
9.00	Yr 4 (1) – 15s	Yr 4 (6) – 14s	Yr 4 (5) – 14s	Yr 4 (4) – 14s	Yr 4 (3) – 15s	Yr 4 (2) – 15s	Yr 5 (1) – 15s	Spare	Yr 5 (5) – 16s	Yr 5 (4) – 15s	Yr 5 (3) – 15s
9.45	Yr 4 (2) – 15s	Yr 4 (1) – 15s	Yr 4 (6) – 14s	Yr 4 (5) – 14s	Yr 4 (4) – 14s	Yr 4 (3) – 15s	Yr 5 (2) – 15s	Yr 5 (1) – 15s	Spare	Yr 5 (5) – 16s	Yr 5 (4) – 15s
11.10 *	Yr 4 (3) – 15s	Yr 4 (2) – 15s	Yr 4 (1) – 15s	Yr 4 (6) – 14s	Yr 4 (5) – 14s	Yr 4 (4) – 14s	Yr 5 (3) – 15s	Yr 5 (2) – 15s	Yr 5 (1) – 15s	Spare	Yr 5 (5) – 16s
11.55	Yr 4 (4) – 14s	Yr 4 (3) – 15s	Yr 4 (2) – 15s	Yr 4 (1) – 15s	Yr 4 (6) – 14s	Yr 4 (5) – 14s	Yr 5 (4) – 15s	Yr 5 (3) – 15s	Yr 5 (2) – 15s	Yr 5 (1) – 15s	Spare
12.35	Yr 4 (5) – 14s	Yr 4 (4) – 14s	Yr 4 (3) – 15s	Yr 4 (2) – 15s	Yr 4 (1) – 15s	Yr 4 (6) – 14s	Yr 5 (5) – 16s	Yr 5 (4) – 15s	Yr 5 (3) – 15s	Yr 5 (2) – 15s	Yr 5 (1) – 15s
1.45	Yr 4 (6) – 14s	Yr 4 (5) – 14s	Yr 4 (4) – 14s	Yr 4 (3) – 15s	Yr 4 (2) – 15s	Yr 4 (1) – 15s	Spare	Yr 5 (5) – 16s	Yr 4 (4) – 14s	Yr 5 (3) – 15s	Yr 5 (2) – 15s
2.30	*Certificate Presentation - SCC*										

*Short session

Figure 2. Bootcamp training day timetable

For the programme to work we needed to put in place support for parents, support for students, technical support and support for teachers. This was done through a number of ways as shown in Table 1 below.

Students	Parents	Teachers	Technical
Boot Camp Cyber safety How to be safe online Basic searching – search engines and how they work Digital Citizenship	Parent education Night planned Parent Training sessions Phone Support from Apple Apple Store – Carindale (Genius Bars)	Planning with Danielle Carter – Term 4 Peer Mentoring Professional Development Day – Supplier	Hot swaps Supplier offers Priority service response (next business day warranty) Apple offers innovative phone support for families.

Table 1: Support Plan for students, parents and teachers for 1:1 laptop programme

The 2012 year quickly flew by. At the end of the year parents and students were surveyed about their experience of using their new laptops during the year. Overall the response was very positive and all parties felt that there had been a very positive outcome for learning through the introduction of the 1:1 laptop programme as shown in Figure 3 below.

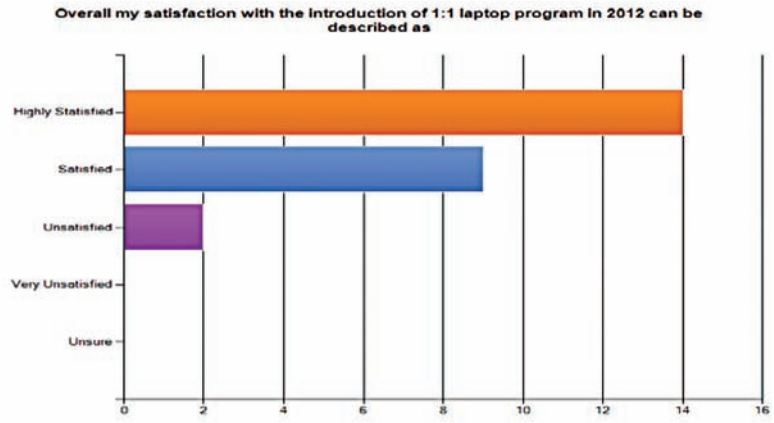


Figure 3. Survey of all parties November 2012 on the 1:1 laptop programme

Personal Reflections Of Staff

Each of the three teachers brought a variety of skills and abilities to this programme. This diversity meant that there were different experiences, fears and expectations on the journey. Therefore, we have each decided to write a personal reflection to show that being different can strengthen a team and contribute to success.

Susan

Figure 4. Susan Ekeberg

I have been teaching for 8 years and was involved in the discussions of the 1:1 laptop programme from the early stages. I was part of the ICLT committee who researched these programmes, the initial school visits and the trial of 1:1 laptops. Even with this knowledge, it was still with nervous anticipation that I headed into the 2012 school year. I still had many questions: How would parents cope with the implementation of such a programme? Were the students mature enough to understand how to use the device correctly and safely? How was I going to use the device, to its full potential, to support the learning of these students?

My class in 2012 presented a wide range of learning styles and abilities and my immediate challenge was: how do I cater for each and every one of these students? This isn't a new challenge for teachers, but, with the laptops in tow, it became both the challenge and the year's blessing all in one. Another challenge for this particular class was co-operative collaboration. They needed support to learn how to work together and, on the flipside, build independent work habits.

The laptop was used in a variety of ways in our Year Five classrooms. It was used as a communication tool; '*Todaysmeet*' (www.todaysmeet.com) was used to chat within the four walls of the classroom and '*Weebly*' (www.weebly.com) was used to communicate with the outside world. It was a tool for collaboration (our challenge!)

Figure 5. Students sharing resources

Students do not always need to be on their own laptop; they may share one laptop between three to work together to solve a problem. It can be a self-regulation tool. Students have at their fingertips at any time the answers to many questions they may have. They just have to be taught the skills to find the answer! With the students using their device regularly they are continually building on their skills and it is making learning more real life for them, which is important for the 21st Century student. It is a mobile device so the time for learning does not just have to be within the four walls of the classroom. My students are on the verandahs recording themselves, making movies and working cooperatively with each other. The link between learning at home and school begins to become more obvious to them. I have some students that developed extra work, built on their skills at home and would come in and show me on their laptop. This isn't new but it was another way to share their learning and it built on the continuity between school and home. Students are able to share their learning in a variety of ways. They can be creative and play to their strengths.

My main challenge for the year was to support the very individual needs of this particular class. The laptop became, as I said earlier, the blessing, as I was able to individualise learning more easily and, I believe, more successfully. I was able to cater for those who need learning support, while also giving those who need it more opportunities for critical thinking, problem-solving and higher-order thinking. Overall, it was an interesting, exciting, challenging and productive year. With open communication, parent satisfaction in the programme was mostly positive and, with the support of my colleagues, I think the programme enhanced the learning of my students and improved my skills as a teacher.

Susan Ekeberg

Cathy

Figure 6. Cathy Hyde

Can I do this? I don't even know how to operate a Mac Computer. How will my teaching change? I am very limited in my knowledge of Interactive Communicative Learning Tools (ICLT). What if my students know more then me? These questions and thoughts were just a few of many that filled my mind as I was asked to take on the 1:1 laptop programme. To be honest, I was really scared. I had been teaching for 25 years and while I had a confident understanding of curriculum and pedagogy and had used computers in some of my teaching, what was being asked of me was way out of my comfort zone. However, I knew two wonderful, young teaching partners, the Leadership Team and support staff from Brisbane Catholic Education, would support me. I had also seen that the trial Susan had done with her class in 2011 was extremely positive for the students. Also, whilst I was nervous, I was open to changing my teaching if it meant better outcomes for my students' learning and setting them up to become successful 21st Century learners.

My class for 2012 consisted of 26 students (13 boys and 13 girls). The class was made up of a diverse range of abilities from students who were above average to two students with significant speech language difficulties, a student with Cerebral Palsy and a couple of students with behavior management issues. Each of them started the year full of excitement that they would be the proud owners of their own Apple Mac. With this came responsibilities. They had procedures to follow for generally looking after it including how to carry the laptop, charging it every night at home, not using it with food or drink, keeping it out of the reach of little brothers and sisters and the family dog (one power cord got chewed in 2012!). They had procedures at school as well including the 45 degree rule: if I needed their attention while they were on their laptops, I called "45", and they knew instantly to close the lid and look and listen. They also knew that if, at any time, they were not on the correct task on their laptops the computers would be taken from them for a period of time. They also needed lots of lessons regarding cyber safety and Digital Citizenship.

At first, I was truly overwhelmed. There were so many procedures to learn, websites to get to know, and technical difficulties with the Macs. I was struggling with how I could best marry this new learning tool with my delivery of curriculum. I adopted the approach of 'slowly, slowly'. I tried to learn and use two new tools each week to deliver my lessons.

Figure 7. Students sharing learning

As well, I adopted the approach that our classroom was a community of teachers and learners. The children soon began teaching me as well as each other. I learnt to relax as they became the experts at operating the Macs and they were so willing to help each other. I had to adopt a new role: I was no longer the teacher but was now the facilitator and coordinator of their learning. Collaboration was central to learning in my classroom.

The year had many positive outcomes. My students amazed me with their creativity, knowledge and their thirst to continue their learning at home which was self driven. They would make i-movies, skype, email, QR-Codes, and research topics of their own interest and improve their basic skills using sites such as www.mathletics.com, www.spellingcity.com, www.studyladder.com and www.kahnacademy.com. The laptop allowed them to present their knowledge and understanding using a variety of tools and in a variety ways. Students who previously had a very negative attitude to school were now engaged and willing to produce creative and informative activities and couldn't wait to get to school each day to learn something new or to show us what they had discovered.

Whilst my learning journey with the 1:1 laptop programme continues to be refined and developed, it has changed how I teach forever. In 2013 we continue to be supported by the Leadership Team and BCE and regularly get to share 'best practice' with each other, other staff at our school and the Cluster Community formed in 2012.

What a journey! Challenging, exciting, collaborative, positive, life-changing!

Cathy Hyde

Scott

Figure 8. Scott Burns

The whole school was aware that we were moving towards a contemporary learning environment and model. Part of this was creating 1:1 classrooms, where students and teachers had 'anytime, anywhere' access to their learning and teaching. I started the 1:1 laptop journey a little later then my teaching partners. At the time when the discussions were being held about the Year Fives beginning the trial and ultimately the pilot year level for the 1:1 laptop programme, I was teaching in Year Four. While I was excited and a little jealous at the prospect of the Year Fives having a 1:1 laptop programme, I was already busy creating the best learning environment I could with the technology I already had access to. Year Four, like most classes at the time, had access to interactive whiteboards, trolleys of laptops that could be used from session to session and a class set of iPods. I enjoy using technology myself and found great value and success when using this technology in my class. Even though I felt comfortable using technology within the classroom, there were still mixed emotions when I was told at the end of 2012, that I would be moving to Year Five the following year. Thankfully, I knew I wasn't alone in this adventure.

Before beginning the programme in Year Five in 2012 and then continuing into 2013 the teachers, including me, were supported in our approach to using the laptops in classrooms. For me the big focus was about seeing the laptop as more than just another device. If they weren't going to be used effectively to enhance the teaching and learning within my classroom then why have them? The support and professional development that we received was invaluable in helping me understand the ideas and practices around what is 21st Century Learning and Skills and new approaches to innovative teaching and learning. With the beginning of this new learning I was ready to start the 1:1 laptop programme.

Figure 9. Students collaborating

Initially, I wanted to get into the new school year and start using the laptops straight away and put into practice what I was learning myself. I soon learnt that this wasn't to be the case. When starting a programme like this it doesn't mean all that you have previously done disappears. I still needed time to get to know my kids, see what they were capable of, and develop rules and expectations, and this was to be done without the laptops. To this day, I still only use laptops when I feel it is necessary and will enhance the learning. If the same outcome can be achieved using paper and pen, then that is what I will do. For me, having a 1:1 laptop programme hasn't meant that I have completely changed my philosophy and pedagogical approach to teaching but I have learnt to change and adapt it to suit the new learners and the environment that I teach in.

By being part of this programme and journey I have seen my own teaching and the learning of my students grow and develop in ways I hadn't thought possible. Having the access to laptops and the approach of 'anytime, anywhere' learning means the students are truly able to become 21st Century learners. They are able to be creative, collaborative, communicative, critical thinkers, problem solvers and real-life learners. Now that I have seen the power of technology when embedded into your teaching and learning practices I don't see how I could turn back. The laptops are part of the culture of the learning in my classroom and while there are still challenges ahead I am looking forward to them.

Scott Burns

Our Top Five Tips When Starting a 1:1 Laptop Programme

1. **Collaboration**
   It is essential to work as a team, both at year and cluster level.

2. **Think Differently**
   Be willing to change: from the learning environment to pedagogy.

3. **Communication**
   Be honest. Learn from each other and the students, keep parents informed and don't be worried to ask for help.

4. **Best Practice**
   'Don't let technology get in the way'. Use the right tool for the right job.

5. **Fun**
   Enjoy the journey – let the children take you to places you've never imagined.

After the success of 2012, the school decided to go ahead and implement the programme across Years Four, Five and Six for 2013.

Figure 10. 21st Century learners

Reference List

ACARA (2011). Australian Curriculum, Australian Curriculum Assessment and Reporting Authority, Sydney, Australia. Accessed at www.australiancurriculum.edu.au

Dede, C. (2009). Comparing Frameworks for '21st Century Skills', accessed at www.watertown.k12.ma.us/dept/ed_tech/research/pdf/ChrisDede.pdf on 14 October 2011

DET (2009). 1:1 computing: Literature review, State of NSW, Department of Education and Training, Curriculum K-12 Directorate Version 3.5 available at www.det.nsw.edu.au/media/downloads/about-us/how-we-operate/national-partnerships-programme/digital-education-revolution-nsw/rrql/research/lit_review.pdf

Gulek, J. C. & Demirtas, H. (2005). *Learning with technology: the impact of laptop use on student achievement*, Journal of Technology, Learning and Assessment 3 (2), available from www.jtla.org

Microsoft Corportion (2010). *Bringing a 1-to-1 Program To Life: A Handbook For Primary School Teachers*. Microsoft Corporation, USA, accessed at www.epotential.education.vic.gov.au/showcase/download.php?doc_id=1163

Russell, M., Bebell, D. & Higgins, J. (2004). *Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops*, Journal of Educational Computing Research, Vol. 30(40) 313-330, Baywood Publishing Co. Inc.

Shear, L., Gallagher, L., & Patel, D. (2011). ITL Research 2011 Findings: Evolving educational ecosystems, SRI International. California, USA, accessed at www.itlresearch.com

A Consideration of the Importance of Quality Mathematical Discussion in Primary Classrooms

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Introduction

Almost forty years prior to the Advisory Committee on Mathematics Education (ACME) Report (2006:3) recommendation that "mathematics lessons need to encourage good quality discussion through increased group and pair work", the view was put forward that children should be at the heart of education (Plowden Report, 1967). This focus has been a clarion call of government papers ever since. Alexander (1992) debated the point that education should be infused with interaction between teachers and pupils, and between pupils themselves. Discussion is widely defined as two or more people talking about a problem in order to find resolution. This paper sets out to show both the advantages and disadvantages of classroom discussion and the strategies teachers can employ to encourage quality discussion through group and pair work.

Advantages

Quality discussion in mathematics lessons helps children to generate their own strategies to succeed (Johnston, Ivey & Faulkner, 2011). Telling children the answer is not the best way to develop independence; facilitating discussion enables them take ownership of their learning (Johnston et.al., 2011). By encouraging discussion in the classroom teachers are leading children on from what they do automatically, that is, 'talk' (Andrews, 1997). Therefore, educators should consider allowing space and time for exploratory talk in order to create an atmosphere of achievement. Cobb, McClain and Whitenack (1997) raise the issue of how important discussion is to the 'sociocultural practices' of questioning, reasoning and justifying (Brown and Hirst, 2007). Talking affords children a range of opportunities to develop their mathematical thinking and in turn this facilitates engagement with the practices of mathematics. Vygotsky (1986) determined that children increase their own learning exponentially when they collaborate with other children and/or the teacher.

Knowledge can be gained through interaction with one another and learning is the result of engaging in social activities. By implementing the Zone of Proximal Development (Vygotsky, 1986) children are supported in their learning, either by their peers or by the teacher. Therefore, they are able to make connections and leaps in their learning that they would not necessarily have achieved unaided. That is, by allowing children to share, explain and discuss their work with one another they are building their own knowledge at the same time as supporting another's.

When Kyriacou and Issitt (2008) completed a study into discussion in mathematics lessons they discovered that when teachers posed more probing questions, rather than yes/no questions, children's learning was more advanced. By asking the right questions teachers can provide children with the opportunity to 'think aloud' and extend their reasoning, beyond just providing an answer to a stage of wanting to enquire more (Brown and Hirst, 2007).

McCrone (2005) purports that pupils can gain exponential knowledge from group discussion that they may not have gained by working on their own. By listening and contributing to group discussion, allowing time for the output of these discussions to be assimilated, pupils can not only see if their own ideas work but also use the knowledge of other pupils to guide and build upon their own knowledge. An example of this might be a child who is struggling to understand fractions, watches another child modelling and discusses what he is doing to reach an answer. The first child can then use this input to attempt the task unaided.

Disadvantages

Potential issues affecting quality discussion in the classroom are less prominent than the advantages, but nonetheless educators need to be aware of them. The issues include children who are more able at maths dominating the discussion since theirs is the loudest and most strident voice, in what becomes a display of their individual knowledge as opposed to a discussion wherein a number a children share and discuss their knowledge (Ball, 1990). This was apparent in observations of a recent Year Two mathematics lesson when the children who were more able invariably supplied answers, without prompting, or engaging in discussion than children who were less able mathematicians. This monopolisation of the group dynamic can lead children who are less able making no effort to engage with the learning since their opinions are never sought.

Where there are a group of children who are confident mathematicians this may lead on to competitive displays of knowledge. This is more likely to occur in Key Stage One when disputational talk often predominates (Ball, 1990). Pupils may claim they are correct, but are unable to clarify why. This is a result of the immaturity of their talking and thinking processes. In Key Stage Two pupils talk is likely to be more exploratory and less confrontational; discussion between peers more likely to extend their individual knowledge.

Furthermore, according to Simpson, Mercer and Majors (2010) it is the teacher's responsibility to manage wrong answers and use them as a basis to help pupils make connections and link their knowledge. This is wholly dependent on the subject knowledge and confidence of the teacher to intervene at an appropriate stage and drive the conversation towards achievement. Not all discussion is conducive to learning. Teachers need to move away from the teacher questions/pupil answers/teacher confirms strategy (Kyriacou & Issitt, 2008), whereby children just display their knowledge, towards more exploratory talk. Lambirth (2009) disputes this but the majority of current research takes the view that exploratory discussion is the path teachers should now be taking.

Not all discussion is mathematically productive and teachers need to be aware of this and keep children on task and draw out responses from less vocal pupils. The discussions need to be productive and a balance has to be found between ensuring curriculum content is covered and time is made for useful and enriching discussion (Sherin, 2002). In some instances the content of the lesson may have to be curtailed in order to allow for good discussion to continue.

Strategies

Teachers can implement at range of strategies in order to encourage good quality discussion through group and pair work and in doing so should consider the following:

Discussion between teachers and pupils can be effected in a whole class scenario (teacher at front, children seated either in rows or grouped in sixes around tables) or in smaller groups and one-to-one scenarios. In reality, rows of desks are only really suited to teacher speaking/children listening although this can work well during the introduction of mathematical concepts since the children's attention will be firmly focussed on the teacher. However, when trying to facilitate group, or one-to-one discussion, it is far better to have children facing one another around tables (Staples, 2007).

Teachers should scaffold children's discussions by asking leading 'open' questions (Kyriakou & Issitt 2008) to further their thought process and help them to make links and connections in knowledge that they would not have made on their own (Vygotsky, 1986). Furthermore, this will help children to understand how to organise their ideas, check understanding and make meanings clearer. Posing the same question, worded differently, to more than one child can encourage more in-depth discussion from children (Simpson et al., 2010).

It is important not to close down discussion by asking closed questions and in addition it is vital that teachers use encouraging language when responding to children's questions (Johnston et al., 2011). By asking open and leading questions pupil's knowledge is shared amongst the group and can then be debated (Tharpe & Gallimore, 1988). Indeed, a strategy employed by some practitioners is to encourage pupils to question the validity of another's responses to encourage further debate and deeper understanding. For example, asking one pupil if they agree with the reasoning or method another pupil has offered as a solution (Ball, 1992).

Classrooms have changed significantly in regards to technology in the last 10 years and the use of interactive white board (IWB) as a means to generate discussion is an important strategy to be able to implement in the classroom; however, it should be noted that the IWB is the tool to producing engaging discussion and not the strategy. Recent research by Mercer, Hennessy and Warwick (2010) confirms that teachers state lessons using the IWB result in more engaged learning with discussion significantly increased. It has long been agreed that using resources is a highly effective way of encouraging children to start a discussion (Ball: 1992), by giving children something tangible to hold the teacher is providing a focus for the ensuing discussion. When children are 'doing' something, the talk can flow effortlessly. For example, give a group of children a set of multilink each to manipulate and ask 'how many different shapes can you make with six blocks?' and then allow them time to work with the resource and discuss with each other.

Conclusion

As stated at the beginning of this essay, over 40 forty years ago the Plowden Report (1967) put children at the heart of the curriculum. Throughout the intervening period research has shown that this has continued to be the voice of government and educationalists, in that it is vital to children's learning that they are given time to voice, debate and discuss their knowledge in order to further their own and other's understanding. It is the responsibility of educators to take up the baton and facilitate this within the classroom. This paper has tried to demonstrate the value of talking for learning in mathematics, showing the link between quality discussion and learning in research. In order for children to achieve greater learning, teachers need to strike a balance between talk for assessment (closed questions) and talk for learning (open questions) and similarly employ a range of strategies to encourage discussion.

References

ACME (2006) ACME Position Paper: Key issues for the future of primary mathematics learning and teaching, Advisory Committee on Mathematics Education, The Royal Society, ACME PR/06.

Alexander, R. (1992) *Policy and Practice in Primary Education*, London: Routledge.
Ball, G. (1990) *Talking and Learning: Primary Maths for the National Curriculum*, Hemel Hempstead: Simon and Shuster Education.

Brown, R., and Hirst, E. (2007) Developing an Understanding of the Mediating Role of Talk in the Elementary Mathematics Classroom in the *Journal of Classroom Interaction*; Vol. 41/42 Issue 2/1, p18-28.

Cobb ,P., McClain, K., and Whitenack, J. (1997) Reflective discourse and collective reflection, in *Journal of Research in Mathematical Education*, Vol. 22(1) pp.3-29.

Johnston, P.H., Ivey, G., Faulkner, A. (2011) Talking In Class: Remembering What Is Important About Classroom Talk in *Reading Teacher*; Vol. 65 Issue 4, p232-237

Kyriacou, C., and Issitt, J. (2008) What characterizes effective teacher-pupil dialogue to promote conceptual understanding in mathematics lessons in England in Key Stages 2 and 3? *EPPI-Centre Report no. 1604R*. London: England. Social Science Research Unit, Institute of Education, University of London.

Lambirth, A. (2009) Ground Rules for Talk: The acceptable face of prescription in *The Curriculum Journal*, Vol. 20 (4), pp 423-435.

McCrone, S.S. (2005) The Development of mathematical discussion. An investigation into a 5th grade classroom in *Mathematical Thinking and Learning*, Vol 7 (2), pp 111-133.

Mercer, N., Hennessy, S., and Warwick, P. (2010) Using interactive whiteboards to orchestrate classroom dialogue in *Technology, Pedagogy and Education*; Vol. 19 (2) pp195-209.

The Plowden Report (1967) *Children and Their Primary Schools*, a report of the Central Advisory Council for Education (England), London: HMSO.

Simpson, A., Mercer, N., and Majors, Y. (2010) Douglas Barnes revisited: If learning floats on a sea of talk, what kind of talk? And what kind of learning? in *English Teaching: Practice & Critique*; Vol. 9 Issue 2, pp 1-6.

Sherin, M.G. (2002) Developing a Discourse Community in a Mathematics Classroom, in *Journal of Mathematics Teacher Education*, Vol. 5(3) pp.205-233

Staples, M. (2007) Making the Most of Mathematical Discussions in *Mathematics Teacher*; Vol. 101 Issue 4, p257-261.

Tharpe, R., and Gallimore, R. (1988) *Raising minds to life: Teaching, Learning and Schooling in Social Contexts*. New York: Cambridge University Press.

Vygotsky, L.S. (1986) (Ed. A. Kozulin). *Thought and Language*. Cambridge, MA: MIT Press

Girls, Mathematics and the Primary Classroom

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"Math [sic] class is tough!" (Barbie, 1992)

Introduction

In 1992, Mattel was forced to apologise to consumers who had bought Teen Talk Barbie dolls, some of which had been programmed to say "Math [sic] class is tough". The company had not apparently anticipated the level of offence that the phrase caused (The New York Times, October 21, 1992). Although historically girls had undoubtedly underachieved in mathematics, by 1992 there had been many interventions to increase both the levels of achievement and the social positioning of girls within the subject (Boaler 2002). In the UK, girls now achieve highly in mathematics at GCSE and A-level, in some years outperforming boys (DfES 2007). At the primary level, there is little difference in the number of girls and boys reaching expected levels at the end of Key Stages 1 and 2 (DfES 2007) and popular conjecture is that primary schoolgirls are now doing fine and no longer require concern (Skelton and Francis 2003); the 'problem' is now one of boys' underachievement in literacy. Given these statistics, I should have no concerns about girls and mathematics but within the statistics, and in my own classroom experience, there are hidden issues that have repercussions for my future practice and which impinge on my value of social justice.

Although the perception of girls outperforming boys at A-level is widespread, the relative gender participation levels are biased towards boys for mathematics – a ratio of 3:2 and over 2:1 for further mathematics. Girls also generally achieve fewer A grades (figures for 2011 [*The Guardian,* 2012]). This would suggest that many girls are both actively rejecting and underachieving within the subject at post-compulsory level. As Skelton, Francis and Valkanova (2007) note, 'gendered choices have consequences for the types of career that students are able to pursue' and such choices are therefore an issue of social justice if, as I believe, girls either feel, or are positioned into feeling, unable to choose mathematics. The media, government and regulator focus on the numbers of children reaching expected levels in primary school has, I believe, clouded two other important statistics – the gender difference in high achievers and girls' progression in mathematics.

'Reading about myths surrounding learning styles and just happened to see "boys outperform girls at Key Stage 2" on the opposite page [DCSF 2009a, 3]. L's teacher said something similar when I went to parent-teacher meeting. Apparently girls aren't getting as many Level 3s as boys and that is why L had "girls-only" maths support in Year 2. Didn't get a level 3 in the end but 2a was a lot better than they were expecting. Will have to see if girls' morning maths club makes a difference in junior school.' (*Reflective journal, Oct 2011*)

Table 1. Key Stage 2: Analysis Of Performance In Sats By Gender (2001-3)

	Percentage of pupils who achieved level 4 or above at KS2			*Percentage of pupils who achieved level 5 or above at KS2*		
	English	**Mathematics**	**Science**	**English**	**Mathematics**	**Science**
Boys in 2003	70	73	86	21	32	40
Boys in 2002	70	73	86	24	29	38
Boys in 2001	70	71	87	22	26	34
Girls in 2003	81	72	87	33	26	41
Girls in 2002	79	73	87	34	25	37
Girls in 2001	80	70	88	35	23	33

Source: Francis and Skelton (2005)

Table 1 illustrates this gender difference from 2001 to 2003; the figure was 4% more Level 5s in 2006 (DfES 2007). Although these figures are occasionally mentioned in the literature (Eden 2008), they do not seem to resonate with authors in the same way they resonate with me. The percentages are single-figure but given the large numbers of primary-age children there are a significant number of individuals underachieving within the population and this appears consistent over time. The government seem unconcerned: 'boys are more likely to succeed at the higher levels between Key Stages 1-3 but this diminishes to a small advantage at GCSE A*' (DfES 2007).

‘Teaching maths tomorrow. Looked at the groupings and noticed there are 2 girls in the most able group of 8. There 18 girls in the class so why aren’t there more? I know I shouldn’t expect all classes to have equal representation but it doesn’t appear to be a class of low-middle achievers. Same story when I was a TA and on observations. In every school I have been in so far there are more boys than girls in the highest ability groups. The teachers don’t even comment on it.’
(*Reflective journal, Nov 2011*)

‘Bothered about the figures in Francis and Skelton. I keep reading that the boys and girls achieve similar results at primary levels but this shows they AREN’T. It seems like more able children don’t warrant concern because they’ll be alright. But if I’m supposed to have high expectations as a teacher, isn’t that for all children?’ (*Reflective journal, Mar 2012*)

Gender issues are complicated by ethnicity, social class and mobility of pupils as pointed out by authors (Skelton and Francis 2003; DCSF 2009c) and my colleagues:

‘L has responded to my email request for experiences with “should be noted, just to throw something else into the mix, the boys were of Asian origin and the girls were white Caucasian”. A said her school was middle-class with high levels of tutoring that probably distorted the school effect.’ (*Reflective journal, April 2012*)

The effect of gender can be untangled through Contextual Value Added (CVA) analysis, which ‘adjusts to account for the impact of certain external or pupil level factors’ (DfES 2007). This shows that ‘taking account of other facts (eg FSM, ethnicity, prior attainment), girls make worse progress than boys in maths at primary school (equivalent to boys making an extra term’s progress)’ (DfES 2007). OFSTED’s view of an effective school is one where ‘girls and boys would make broadly similar progress in relation to their abilities’ (OFSTED/EOC 1996). Therefore, on a national scale, primary schools are proving ineffective teachers of mathematics. In summary, despite reaching *expected* levels for mathematics, girls *make less progress overall than boys* and are less likely to achieve the highest levels within primary school.

‘In all the books and articles I have read, I have never seen this CVA statistic before. It is hidden away in this report. Why isn’t anyone concerned? What is going on in primary schools?’ (*Reflective journal, April 2012*)

In her feminist critique of mathematics education, Mendick (2006) writes, “There is something not quite honest about my presenting clean cut graphs and statistics as the starting point for this book. Statistics have to become significant for a person and numbers have to be noticed”. Reflecting on why these statistics have such resonance for me, I have concluded that although social justice is one motivation, emotion plays an equal part. Discussion about reflective practice often invokes ‘values’ as motivation for practices/ethos within school; beliefs are explained in terms of values that can be negated or reinforced. However, explanations for actions/beliefs expressed solely in terms of values are reductionist and do not allow emotion to exist in its own right. Mathematics triggers complex emotions for me as a female who studied mathematics to A-level and beyond as part of a science degree. Mendick (2006) writes:

“*While not a health endangering addiction, being a mathematician is a culturally- and socially-marked category of identity. It is something that is difficult to admit. It has the power to impress, intimidate and alienate others, its mention often evokes in them painful memories of their own experiences of school mathematics.*”

I was never bullied or singled out but, nevertheless, felt ‘other’. I could say that I don’t want others to feel like this and this is because of my value of empathy but that would be overanalysing. As the mother of four primary-aged children – a dyslexic boy who is mathematically able but struggles with memory and speed, a numerate girl, a girl with a fear of mathematics and a gifted and talented (mathematics) boy – I am also confronted daily with my children’s range of emotions about maths and my emotional responses, in particular the dichotomy between not believing in stereotypes but living with two.

These emotions have influenced my concern about mathematics and therefore my position. My position has evolved from a simplistic knee-jerk reaction of promoting fairness and equity in achievement for girls to a concern about the nature of mathematics itself. I do not wish to link correlation and causation but I believe the CVA and Level 5 statistics are indicative of a primary classroom culture that allows girls to succeed at mathematics but not identify themselves as able mathematicians.

My position is that **a classroom culture that positions children as 'mathematicians', as opposed to 'learning maths', in the primary years could increase girls' participation and achievement in mathematics in the post-compulsory years and therefore widen their economic opportunities.** In the remainder of this essay I show how I came to adopt my position, the order of discussion not necessarily reflecting the evolution of my thinking. The etiology of gender differences and mathematics is vast, conflicting, confusing and often emotive (Salomone 2003); the causes of differences are varied and often elusive (Fennema 1996). It has been challenging to impose order and coherence to my argument. I have tried to record my reflections in a linear fashion although they did not occur in that way.

Biology, Psychology, Cognition And Mathematics

Biology and Mathematics

I am inherently wary of any explanation that seeks to explain gender difference purely in terms of physical or psychological attributes. Historically, female underparticipation within society has often been justified in terms of women being the 'weaker sex' through disposition or biology. In particular, inequities in mathematical achievement were explained in terms of inadequacies within the female brain (Ivinson and Murphy 2007).

> More feedback today from PG13. A suggested the difference was that boys processed in a 'cold' logical fashion (which suits maths?), whereas female brains work a little differently. HUGE issues with that, particularly in suggesting 'cold'. Puts boys in binary opposition with 'warm' and presumably 'fluffy' girls.
>
> A did say though maths was a subject the boys felt confident in, they just knew they could do it. N also said that she found the girls less willing to have a go whereas the boys tried and were less inhibited. That reflected my classroom practice as well. Might be something in that. (*Reflective journal, April 2012*)

Slavin (2009) asserts that 'there are no male-female differences in general verbal ability, arithmetic skills, abstract reasoning, spatial visualisation or memory span'. Other authors make bold, opposing statements:

"Much of the new research has demonstrated that the brains of boys are markedly different – anatomically, functionally and hormonally – from the brains of girls. The genders learn differently, and even see and hear differently. These differences are real and they are corroborated in boys and girls throughout the world and across cultures". (*Gurian et al* 2009)

They then follow this with minor clarifications, "It is crucial that we all agree that every child is an individual, and that male and female brain differences vary both between boys and girls, and among boys and girls". (*Gurian et al* 2009). These clarifications do not go far enough because in reality there are many more differences between children of the same sex than between the sexes (DCSF 2009a). As Bayley and Featherstone (2009) comment, "If we lined up all the boys and all the girls on the basis of almost any characteristic, there would be lots more overlap than difference attributable to only one gender". Elucidating patterns and trends and drawing generalisations is, however, essential in proposing solutions to large-scale phenomena, with the proviso that within these trends there is much individual variation.

With regard to mathematics, brain imaging has highlighted greater development in the spatial processing regions of some boys (Gurian et al 2009) and some researchers have reported gender differences in the use of spatial problem-solving strategies (Gutiérrez and Boero 2006) although this is contended by Slavin (2009). The brain's plasticity (Sharp and Murphy 2009), however, means that spatial reasoning can be developed with training (Gallagher and Kaufman 2005); authors point to the importance of engaging young girls in activities involving spatial awareness within the early years (Bayley and Featherstone, 2009; Gurian 2009).

Psychology and Mathematics

More contentious are neuroscience's findings that the genders process information in different ways. But as Sharp and Murphy (2009) state, "knowing about which areas of the brain are active when we perform very specific tasks is one thing. Determining the exact nature and how it results in learning is something else". This has not prevented different 'learning styles' being attributed to each gender, for example, boys like logic, are less verbal, reason deductively and are risk-takers and competitive, whereas girls reason inductively, are more verbal, find abstraction hard and work cooperatively and collaboratively (Bayley and Featherstone, 2009). Despite neuroscientists cautioning that, "the working of the human brain is simply far too complex to formulate any sensible, practical, everyday educational application even in its broadest sense" (Sharp and Murphy 2009), educators often draw two conclusions: the nature of mathematics aligns itself more readily with boys' brains so girls are disadvantaged, or that mathematics should be taught in collaborative groups to facilitate girls' learning.

The first conclusion would imply that successful girls have more male brains (and mathematics is 'male') and the second that mathematics is individualistic and competitive. I do not align myself with either of these conclusions. I would first need to subscribe to a view of biological determinism; that traits are fixed. Improved results through intervention strategies and changing attitudes would suggest that ability is "changeable and not carved in biological stone" (Salomone 2003). Bayley and Featherstone (2009) point out that, "whether differences exist because a 'boy brain' has a different type of hardwiring to a 'girl brain', or whether they are cultural nobody seems sure". Environment has a strong role in reinforcing pathways and preferences are more likely due to social norms (DCSF 2009a; Slavin 2009). Teaching strategies can have the effect of reinforcing learnt behaviours, for example girls working cooperatively in groups (Salomone 2003), whereas we should perhaps be looking to encourage girls to take risks and be competitive. However, this view of mathematics as competitive, logical and requiring risk is misleading and discussed later.

Some researchers have looked towards the beliefs girls have about themselves and mathematics.
"There is considerable research and inspection evidence to suggest that although an individual's attitude to learning is clearly not predetermined by their gender, there are tendencies for girls and boys to respond in certain general way in given circumstances". (OFSTED 1996)

Claxton (1999) has commented that, "it is perhaps learners' implicit beliefs about 'ability' itself that have the most dramatic impact on their learning power". Researchers have found that during the primary years, girls begin to have less confidence in their ability to succeed in intellectually challenging tasks. More able girls seem to be particularly affected. Licht and Dweck (1987) point out that "while girls are more likely than boys to use ability as an explanation for failure, they are less likely than boys to use ability as an explanation for their success". The authors use the term 'learned helpless' to describe children who avoid situations that hold the threat of failure. They suggest that successful girls are particularly vulnerable because 'by definition they meet difficulty less often than the unsuccessful' (Dweck, 1987 cited in Claxton 1999). Boaler (2002) is critical of Dweck's work because it is an example of 'blaming the victim' and 'putting the responsibility for change firmly at the feet of the girls' (cf Dowling 1998). I believe girls are underachieving in mathematics classrooms for complex reasons. Looking towards psychological or physiological causes alone reflects a Piagetian view of knowledge and belief construction as an individual pursuit. I believe in a Vygotskian social-constructivist paradigm and that meaning is socially constructed. It is necessary however, to look beyond such global theorists to explain the positioning of girls by themselves and others within a particular classroom/societal culture.

Girls' Identity And Gender Constructions

"Mankind likes to think in terms of extreme opposites. It is given to formulating its beliefs in terms of either-ors between which it recognizes no intermediate possibilities". (Dewey 1938)

Definitions of Gender

From the earliest years children live gendered lives, as revealed in their preferences for favourite toys to the choices of school subjects (Walls 2010). Although teachers may view themselves as gender-neutral in their approaches to teaching, school, society and the curriculum itself are gendered. Children do not just exist in a gendered world, they actively construct and enforce their own and other children's gender identities (Francis 2000).

Definitions of gender vary from simple, for example 'gender is a psychological term describing our awareness and reaction to our biological sex and is affected by biological, psychological and social factors resulting in characteristics that are either masculine or feminine' (Bayley and Featherstone 2009), to complex.

> Reading Mendick (2006). 'Masculinity is simultaneously a place in gender relations, the practices through which men and women engage that place in gender and the effects of these practices in bodily experience and culture.' I didn't think it was as simple as masculine/feminine, male/female but didn't realise how complicated it could actually be. How am I going to relate this to primary schoolchildren? I have read too much. It was so simple! Think I have bitten off more than I can chew. Should have picked something else. Don't feel as passionate about other concerns though. (*Reflective journal, April 2012*)

The question is, 'is it possible to establish meaningful generalisations without constructing stereotypes?' (OFSTED/EOC 1996), eg male/female, masculine/feminine behaviours. I do not find socialisation theories of gender provide an adequate explanation for the 'problem' with mathematics. Within socialisation theories, socialisation 'is assumed to produce in girls particularly feminine cognitive and/or affective properties which distinguish them from boys and result in differential performances in school mathematics' (Dowling 1998). The problem is these social representations of gender produce an oppositional, binary divide that is fixed – what one is the other is not (Ivinson and Murphy 2007). However, the 'problem' of gender and mathematics varies over time, culture and context as shown in the wide range of mathematics results in world-wide assessments such as PISA and TIMMS (Steinthorsdottir 2010) indicating perhaps more fluid definitions and constructions of gender.

Gender Discourses

I have indicated one limitation in socialisation gender theory when considering the contradiction between a binary opposition that is fixed, and more fluid gender problems over time and culture. Gender difference undoubtedly has its origins in the social contexts, processes and actions that children experience (Mendick, 2006), however, socialising theories that assume children to be passive receivers of information do not take account of how children construct and actively enforce their own perceptions of gender. The effect of this can be seen in the failure of many sex-role socialisation initiatives (Skelton and Francis 2003) which assume that children will transgress their gender roles through passive exposure to 'positive' images such as heroic princesses and male nurses. Not only do children actively resist such concepts, there are other issues to consider. For example, Mendick suggests (2006) 'using female role models to support female participation in maths reinforces the alignment of gender binaries by suggesting that only women can be role models for other women'. In discussions about boys, literacy and feminisation of schools, it is often suggested that we need more male teachers, however, this also perpetuates the idea that only male teachers can provide role models for boys (Francis 2000), and it seems that primary school children themselves do not regard the gender of a teacher as important (Carrington et al 2007; Skelton et al 2009).

I have found the ideas of poststructuralism useful in that they place gender within discourses within society. Discourses 'determine what can be said about something as well as who can say it, and even what can be thought or imagined; they are, of course, imbued with values' (Mendick 2006). Discourses within the home might place a value on one aspect of behaviour and align it either feminine or masculine; educational discourses might value one subject over another; the discourse within a class might value different gendered behaviours. Sex-role socialisation fails because the children cannot step outside the discourses that surround them because to do so would be 'other' (Francis 2000). Therefore if the discourses within a class align mathematics with masculine behaviours, it may be difficult for a girl to then identify herself with maths if she identifies herself with feminine behaviours; similarly it would be difficult for a teacher to do the same. In this paradigm gender is relational rather than oppositional, ie masculine/feminine behaviours are negotiated differently in different contexts and are not necessarily aligned to sex. Mendick explores that possibilities of viewing those girls who do align themselves with maths as examples of female masculinities (2006); whether maths is masculine is discussed later. I agree with her statement that 'it is not the existence of particular binaries that matters but their underlying logic and pattern … this logic structures our thoughts and feelings and marks out what it is possible to think, to feel and to be' (2006).

Mathematical Epistemology And Gender Constructions

"Mathematics is what the discourses say it is." (Mendick 2006)

Discourses and Mathematics

The discourses of society have deemed maths to be a powerful resource and a form of currency in the marketplace. However, the discourses in society do not necessarily value mathematicians themselves so highly who are often perceived as 'different'. Mendick makes an interesting suggestion when she says, 'perhaps if we move away from 'valorising' mathematics as the ultimate intellectual achievement, it will make it less other' (2006). I have commented before how difficult it is for children to step outside the dominant discourses. I am certain that within a primary classroom the intention of the teacher would be that this discourse does not exist, but children feels its influence in wider society and images presented to them by the media; teachers themselves are subject to their own experiences of mathematics.

Mathematics is perceived as hard, logical and comprising a fixed and inert body of knowledge (Hanson 2004). Able mathematicians are expected to work quickly through numerous problems, take risks and be competitive (Boaler 2002). This epistemological view of mathematics often finds its way into the curricula of schools. But these representations of mathematics are false (Burton 1996). Having a dyslexic and able son has given me insights into the common association of being able at mathematics with working quickly.

> D's teacher asked to see me today. She asked how I thought he was doing in maths. I said I thought he was struggling not with the content but the pace of the lessons. Apparently he had got awful results in the test before Christmas. I asked if it was timed and it was. I explained that he needs extra time because of his dyslexia. She said she was going to move him out of the top set for a while to see how he goes because she felt he was struggling. (*Reflective journal, March 2006*)

> D came home today pleased with himself. Apparently his teacher in his new maths set told him he is way too good for the mathematics they are doing and they can't keep up with him. He got outstanding results in his last test. Going back to his old group next week. Has he improved because the pace of the lessons was slower and there were more games? Or is he still the same but better in comparison with his new peers? Or has being top of the group by a long way increased his confidence? Did he change? Did the maths change? Was the test different to the one he might have taken in the other group?
> (*Reflective journal, April 2006*)

The mathematician's view is that mathematics is 'about illuminating relationships such as those found in shapes and nature; a way of expressing relationships and ideas in numerical, graphical, symbolic, verbal and pictorial forms', (Boaler 2008). Mathematicians work collaboratively in a 'process of conscious guessing about relationships, refining then proving; such work is exploratory and creative' (Boaler 2008). Nickson (2004) asserts that there needs to be a 'change in the perceptions of the nature of mathematics from a "given" abstract body of knowledge to one that is seen as social and a result of shared consensus'. In an era of SATs, levels and teacher accountability, the question is how often do children get to explore school mathematics in this way? Not often according to Kelly (2003) who found the vast majority of primary school children worked in a 'labourer', 'mechanic' or 'performer' way; only a small percentage worked in the same way as mathematicians. Some authors contend that moving towards a more collaborative, language-intensive process will benefit girls because it better suits their cognitive styles (Rodgers 1990). I agree that it could benefit girls but not because it caters to a stereotype of cognition. A truly mathematical approach allows children to make mistakes, find different solutions and be creative; aspects of learning that prepare all children to approach challenges confidently and resiliently, but something able girls often struggle to do. As Hanson (2004) comments, learning mathematics involves challenge and the 'challenge to the teacher is to create situations of mathematical challenge that all can enjoy'; however, there needs to be a balance of challenge and success (Burton 1990). It would be simplistic to suggest that one particular teaching strategy, ie collaborative problem-solving, would result in all inequities disappearing. In addition, as classroom teachers we may have an epistemological view of mathematics at odds not only with the view of curriculum authors but also at odds with the interpretation of the syllabus within school and, therefore, have barriers in its enaction.

The Gender Of Mathematics

> N has responded by saying that it just felt within her class that maths was not a girly thing, she didn't say whether this was her view as well. Well you wouldn't. It does mean though that she is associating maths with the masculine. I wasn't away maths had a gender. (*Reflective journal, April 2012*)

The dominant discourses therefore value but also misrepresent mathematics. As I have stated, I do not believe in different gender 'learning styles' and do not contend that the pedagogy of maths as presented in the classroom, that is logical, fixed and challenging, is therefore unsuitable for girls. As Walls (2010) notes, 'the issue appears not to lie with girls' differing mathematical abilities or learning styles, nor with the pedagogies of mathematics that do not cater to girls cognitive needs but with something much more deep-seated and therefore difficult to address.'

If we subscribe to the view of mathematics as a logical, value-free field (Fennema 1996) then it is difficult to perceive how the subject could be gendered. However, the nature of knowledge, who decides that knowledge and how it is presented, all occur within discourses in society that are heavily gendered. The feminist perspective is that the discourses ascribe 'typical' mathematical approaches with masculine behaviour, for example competitive, fast, high risk. Although I might not agree with all their conclusions, in particular sources of power, I have found the feminist critique of mathematics useful in reflecting on this. If we accept that mathematics is not socially represented as a gender-neutral subject but as masculine in its construction then there is the possibility that teachers are unconsciously less likely to associate girls with higher level mathematics.

Positioning Of Girls And Teacher Beliefs

Positioning of Girls in the Classroom

"*The more things change the more they stay the same.*"
(Attributed to Alphonse Karr [1808-90])

"Although there is an assumption that females and males receive an equal education when they are in the same classrooms, with the same teacher, using the same books, the assumption may be false, as circumstantial evidence uncovered in classroom studies suggests" (Rogers 2008, 84)

Where learning takes place, its 'situatedness', is a primary consideration (Nickson 2004), as is the 'hidden' curriculum in primary schools (Clarricoates 1987). Although the vast majority of teachers would claim equality of opportunity and access to be at the core of their philosophies of education, the literature on gender within the primary classroom would suggest that despite the espoused view that stereotyping no longer exists, little has changed for girls (Francis 2000; Skelton and Francis 2003).This differential approach resulting in different experiences for boys and girls is not intended by teachers.

There remains an 'overall gender polarity that tends to position "attitude" (questioning, challenging) as masculine in opposition to "academic application" (diligence, pleasure in learning) as feminine' (Salomone 2003). 'Typical' girls are nice, cooperative and conscientious. 'Typical' boys are dominant, demanding but rewarding to teach; more able boys are 'naturally bright but lazy' (Salomone 2003). This latter view therefore puts more able girls in the position of being hard-working but without the natural flair of boys. Research within the classroom has shown how this differential perception of girls as achieving through hard work and boys as innately clever persists (Skelton and Francis 2003). Perhaps it is the case that despite espoused recognition that individual girls can be 'brilliant', enacted views within classrooms nationally for girls as a whole are somewhat different.

This matters because if society's (and teachers') view of able mathematicians is of having natural talent and flair, and as a whole society and teachers are less likely to attribute these qualities to girls, then are teachers really being gender-neutral when they decide more able groupings? Guidance from OFSTED and the Equal Opportunities Commission on the Sex Discrimination Act stated that 'schools should make efforts to use setting criteria which do not disadvantage either sex' (1996), but my experiences of underrepresentation at the more able levels and the discrepancy in Level 5 achievement would indicate that perhaps schools were unconsciously disadvantaging some girls. The question is is it girls or teachers who do not identify girls with mathematics? Are there less level 5s because girls are underachieving or is it because they are not put in the position of taking them? In terms of progression, OFSTED have noted that, 'in some subjects, girls can work below their potential by maintaining a high level of activity but in fairly low-level tasks' (1996). It may therefore be that teachers perceive girls as successful and making progress when perhaps they are not as evidenced in CVA scores.

There has been much debate (often controversial) as to whether it is better to teach girls separately for mathematics, particularly within secondary schools. Often the reasons given are catering to different learning styles and space away from dominant, misbehaving boys. From my point of view looking through the lens of mathematics, authors report that in single-sex schools, girls are more likely to identify with mathematics and identify themselves as able (Elwood and Gipps 1999). Within the primary classroom, positive results in terms of achievement are reported from Australia (Wills 2007) although no benefit was found in Norway (Manger and Gjestad 1997). A UK study found, however, that the benefit to girls was at the expense of boys (Power 2008). It is interesting to note that within all-girl group situations, girls have been shown to 'exhibit high competitive levels, but spontaneously help those who lag behind' (Rogers 2008, 93). This could be seen to show that collaboration and competition can coexist; maybe it is therefore possible to teach mathematics in a collaborative meaning-making way whilst giving girls the competitive, riskier strategies they need to succeed in examinations.

Positioning of Girls Outside School

I have not yet considered how girls are positioned outside the school primarily because it is not within my ability to change, however, I need to be aware of external discourses that affect the behaviours children bring to class. Research has found that children's perceptions of their abilities in mathematics are directly influenced by parents' beliefs about their children's academic competencies as well as academic performance (Olson et al 2010). In particular, 'parents of daughters believed that their daughters had lower mathematical ability than did parents of sons, even when girls received better grades than boys in mathematics. Furthermore, mothers of sons overestimated their sons' mathematical abilities and underestimated their daughters' abilities' (Olson et al 2010).

> Reading about parents' beliefs about children's mathematical ability. Made me think about how my brother is considered to be the intellectual. I suppose he did the maths degree and I only did chemistry. Why do people put maths on such a high pedestal? Determined not to do the same with my children. Are my boys really better at maths like the teachers say or am I not seeing how good the girls are? (*Reflective diary, April 2012*)

Researchers report that parents who convey to children that they can understand mathematics are likely to produce self-efficacious children and influence subsequent academic and career choices (Olson et al. 2010). It is clear that 'parents' own mathematical self-efficacy relates strongly to their expectations for their daughter's performance' (Rogers 2008). As a classroom teacher I may not have much influence over parents but a whole-school approach of promoting mathematics to parents might help break the cycle of negative reinforcement at home.

Teacher Identity and Belief

Researchers have found that although three-quarters of people thought both genders could be equally good at mathematics, a far greater proportion of females than males expressed serious concerns about the subject (Hanson 2004). Given the dominance of female teachers within primary schools, this could have consequences for girls and mathematics. There are large numbers of teachers with 'feelings of anxiety helplessness, fear and even guilt about mathematics' (Rodgers 1990).

Maths lecturer offered an extra session today concentrating on what you need to know for the national skills tests. Asked who would be interested and there was almost a stampede. Everyone in our group is intelligent and able. Why are they so scared by mathematics? (*Reflective journal, April 2012*)

If I consider the pedagogy of mathematics when I was at school, I, along with many other trainee teachers, was taught a set of dull, decontextualised procedures (Hodgen and Askew 2007) with right or wrong answers. It is easy for a child to make the association that if you get an answer wrong, you must not be clever at that subject and these feelings often continue into adult life. Hodgen and Askew (2007) note, 'fundamental changes in teachers' beliefs involve far more than "fixing" or "topping up" teachers' "inadequate" knowledge. Professional change involves at least in part becoming a different teacher and a different person'. I believe that as teachers we need to analyse our feelings towards mathematics and that it is our professional responsibility to consciously reflect on how we perceive the subject and those who are able rather than assuming 'topping up' our subject knowledge will make us better teachers.

Future Practice And Conclusions

I realise now that my initial thoughts were about proving the mathematical equivalence of girls in terms of equity of results. However, I cannot assume that 'if overall educational outcomes are equal for populations of girls and boys then the system is functioning in a gender-neutral way' (Ivinson and Murphy 2007). I now agree with Mendick (2006) in that:

"The issue was never about 'girls' and 'boys' real performances but the stories we tell about them, the discourses in which they are inscribed and the positions these make available to learners."

Biology, psychology, pedagogies and gender-biased assessment have all been put forward to explain differential achievements. However, these have largely been discredited (Skelton et al 2007; DCSF 2009b) and we are left with pupil constructions, and I would argue, teacher constructions, of identity and how these relate to the surrounding discourses. I also believe the discourses surrounding the nature of the epistemology of mathematics, and therefore its pedagogy, play their part. As Leder (1990) notes, these varying effects have a cumulative impact that 'may ultimately be translated into differences in achievement and participation'. It is impossible to identify individually sources of inequity and subsequently address each one; within every classroom there is a 'variation in the perspectives both of [mathematics] and of the roles each of the players has of what mathematics teaching and learning is all about' (Nickson 2004). This makes solutions difficult and individual to each teacher, class and school. However, I do believe that a classroom culture that positions children as 'mathematicians' rather than 'learning mathematics' will enable girls in particular to identify more readily with the subject. For my future practice I will therefore need to consider the following:

- be aware of my own identity, how I have constructed this and how I express this, or how I am allowed to express this, within the classroom;
- reflect on my pedagogy of mathematics and compare/contrast to the school/society view of mathematics remembering that it is unrealistic to presume that I can construct a mathematics classroom that is creative, discursive, cooperative and enquiry-based in a SATs-focused school;
- consciously reflect on my interactions with and expectations for all children within my class;
- look at how the girls in my class have constructed their gender identity, especially with regard to mathematics;
- consider an extra-curricular girls' mathematics group if girls don't appear to identify with mathematics, not because this caters to girls' learning styles or provides a space away from disruptive boys but to remove any possibility of binary oppositioning by the girls, ie putting themselves in opposition to the boys; and,
- where there is an emphasis on mathematical performance, consider how to give those girls who appear to be underachieving strategies to succeed, which may include taking risks and making mistakes in a collaborative atmosphere.

In summary, by reflecting on myself, my pupils and mathematics within the wider context I can make 'a wider range of discursive positionings/stories open to a wider range of individuals' (Mendick 2006) and begin to ensure that I teach mathematics in a socially-just manner.

References List

Bayley, R. and Featherstone, S., (2009). *Boys and girls come out to play*. London: A&C Black Publishers.

Boaler, J., (2002). *Experiencing school mathematics: traditional and reform approaches to teaching and their impact on student learning*. Abingdon: Routledge.

Boaler, J., (2008). *What's math got to do with it?* New York: Viking Penguin.

Burton, L. (ed), *Gender and mathematics: an international perspective*. London: Cassell Education.

Burton, L., (1996). 'A socially just pedagogy for the teaching of mathematics', in Murphy, P. and Gipps, C., *Equity in the classroom: towards effective pedagogy for girls and boys.* London: Falmer Press/UNESCO Publishing, pp136-144.

Carrington, B., Francis, B., Hutchings, M., Skelton, C., Read, B. and Hall, I., (2007). Does the gender of the teacher really matter? Seven- to eight-year-olds' accounts of their interactions with their teachers. *Educational Studies*, 33(4), pp397-413.
books. London: Routledge.

Clarricoates, K., (1987). 'Dinosaurs in the classroom – the "hidden" curriculum in primary schools', in Arnot, M. and Weiner, G. (eds), *Gender and the politics of schooling*. London: Hutchinson Education, pp155-165.

Claxton, G., (1999). *Wise up: the challenge of lifelong learning*. London: Bloomsbury Publishing.

DCSF, (2009a). *Gender and education – mythbusters: addressing gender and achievement: myths and realities*. Nottingham: DCSF Publications.

DSCF, (2009b). *Gender issues in school – what works to improve achievement for boys and girls*. Nottingham: DCSF Publications.

DCSF, (2009c). *The gender agenda: final report*. Nottingham: DCSF Publications.

Dewey, J., (1938). *Experience and education: the Kappa Delta Pi lecture series*. New York: Collier Books.

DfES, (2007). *Gender and education: the evidence on pupils in England*. Nottingham: DfES Publications.

Dowling, P., (1998). *The sociology of mathematics education: mathematical myths/pedagogic texts*. London: The Falmer Press.

Eden, C., (2008). 'Gender and educational achievement', in Ward, S. (ed), *A student's guide to education studies*. Abingdon: Routledge.

Elwood, J. and Gipps, C., (1999). *Review of recent research on the achievement of girls in single-sex schools*. London: Institute of Education.

Fennema, E. (1996). 'Scholarship, gender and mathematics', in Murphy, P. and Gipps, C., *Equity in the classroom: towards effective pedagogy for girls and boys*. London: Falmer Press/Unesco Publishing, pp73-80.

Francis, B., (2000). *Boys, girls and achievement: addressing the classroom issues*. London: RoutledgeFalmer.

Francis, B. and Skelton, C., (2005). *Reassessing gender and achievement: questioning contemporary debates*. Abingdon: Routledge.

Gallagher, A. and Kaufman, J., (2005). *Gender difference in mathematics: an integrative psychological approach*. Cambridge: Cambridge University Press.

Gurian, M., Stevens, K., Daniels, P., (2009). *Successful single-sex classrooms: a practical guide to teaching boys and girls separately*. San Francisco: Josey Bass.

Gutiérrez, A. and Boero, P., (2006). *Handbook of research on the psychology of mathematics education: past, present and future*. Rotterdam: Sense Publishers.

Hansen, M., (2004). 'Learning and mathematics', in Ward, S. (ed), *Education studies: a student's guide*. London: RoutlegeFalmer.

Hodgen, J. and Askew, M., (2007). Emotion, identity and teacher learning: becoming a primary mathematics teacher. *Oxford Review of Education*, 33(4), pp469-487.

Ivinson, G. and Murphy, P., (2007). *Rethinking single-sex teaching: gender, school subjects and learning*. Maidenhead: McGraw-Hill Education.

Kelly, P., (2003). Children's experiences of mathematics. *Conference Proceedings of British Society for Research in Learning Mathematics*, 23(2), pp37-42.

Leder, G., (1990). 'Gender and classroom practice', in Burton, L. (ed), *Gender and mathematics: an international perspective*. London: Cassell Education.

Licht, B. and Dweck, C., (1987). 'Sex differences in achievement orientations', in Arnot, M. and Weiner, G. (eds), *Gender and the politics of schooling*. London: Hutchinson Education, pp95-105.

Manger, T. and Gjestad, R., (1997). Gender differences in mathematical achievement related to the ratio of girls to boys in school classes. *International Review of Education*, 43(2/3), pp193-201.

Mendick, H., (2006). *Masculinities in mathematics*. Maidenhead: Open University Press/McGraw-Hill Education.

Nickson, M., (2004). *Teaching and learning in mathematics education: a guide to recent research and its applications*. London: Continuum.

OFSTED/Equal Opportunities Commission, (1996). *The gender divide: performance differences between boys and girls at school*. London: HMSO.

Olson, M., Olson, J., Okazaki, C., La, T., (2010). 'Conversations of parents and children working on mathematics', in Forgasz, H., Rossi-Becker, J., Lee, K., Steinthorsdottir, B. (eds), *International perspectives in gender and mathematics education*. Charlotte, North Carolina: Information Age Publishing.

Proud, S., (2008). *Girl power? A analysis of peer effects using exogenous changes in the gender make-up of the peer group*. Bristol: Centre for Market and Public Organisation, CMPO Working Paper Series, 08/186.

Rodgers, M., (1990). 'Mathematics: pleasure or pain?', in Burton, L. (ed), *Gender and mathematics: an international perspective*. London: Cassell Education.

Rogers, K., (2008). 'For better or worse: classroom dynamics in single-sex science classes', in Spielhagen, F. (ed), (2008). *Debating single-sex education: separate and equal?* Maryland: Rowman and Littlefield Education.

Salomone, R., (2003). *Same, different, equal: rethinking single-sex schooling*. New Haven and London: Yale University Press.

Sharp, J. and Murphy, B., (2009). 'The mystery of learning', in Sharp, J., Ward, S. and Hankin, L. (eds), *Education studies: an issue-based approach*. Exeter: Learning Matters.

Skelton, C., Carrington, B., Francis, B., Hutchings, M., Read, B. and Hall, I., (2009). Gender 'matters' in the primary classroom: pupils' and teachers' perspectives. *British Educational Research Journal,* 35(2), pp187-204.

Skelton, C., and Francis, B. (eds), (2003). *Boys and girls in the primary classroom*. Maidenhead: Open University Press.

Skelton, C., Francis, B. and Valkanova, Y., (2007). *Breaking down the stereotypes: gender and achievement in schools.* Manchester: Equal Opportunities Commission, Working Paper Series, 59.

Slavin, R., (2009). *Educational psychology: theory and practice.* New Jersey: Pearson International.

Steinthorsdottir, O., Dadisman, K., Robertson, D., STeinthorsdottir, K., (2010). 'Mathematics achievement in Icelandic playschools: examining when gender differences emerge', in Forgasz, H., Rossi-Becker, J., Lee, K., Steinthorsdottir, B. (eds). *International perspectives in gender and mathematics education.* Charlotte, North Carolina: Information Age Publishing.

The Guardian, (2012). A levels 2011: the complete exam breakdown by subject, school, and sex. [Accessed online at www.guardian.co.uk/news/datablog/2011/aug/18/a-levels-analysis-subject-school.]

Walls, F., (2010). 'Freedom to choose? Girls, mathematics and the gendered construction of mathematical identity', in Forgasz, H., Rossi-Becker, J., Lee, K., Steinthorsdottir, B. (eds). *International perspectives in gender and mathematics education*. Charlotte, North Carolina: Information Age Publishing.

Wills, R. C., (2007). A new and different space in primary school: single-gendered classes in coeducational schools. *Educational Studies*, 33(2), pp129-143.

What Strategies Should Be Undertaken to Effectively Progress Education for Sustainable Development in Secondary Schools? A Case Study of State Schools in The London Borough Of Richmond Upon Thames

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Abstract

The purpose of this investigation was to identify strategies that could progress Education for Sustainable Development (ESD) in secondary schools. As the effects of climate change, peak oil and population growth become more apparent, the increasing need for ESD has been recognised. Yet studies have shown that the majority of schools exhibit a lack of awareness of sustainable development, and are inconsistent and uncoordinated in their teaching. Questionnaires and interviews with teachers across four secondary schools in the London Borough of Richmond upon Thames were analysed. Results indicated that the 58% of teachers agreed ESD was an important subject that should be mandatory. However, 76% of respondents felt they were not prepared to teach ESD during teacher training. Nationally recognised ESD schemes appeared to have little impact on the schools and only 17% of respondents utilised non-governmental organisations (NGOs) to assist with teaching or ESD support. Teaching and preparation time, lack of training and resources were cited as the biggest barriers to teaching ESD. Central and local government were questioned about their policy decisions and support for ESD. Despite announcing a commitment to sustainable development, the Coalition Government has withdrawn substantial support for ESD citing evidence to support their decisions that does not appear to justify their actions. Including sustainability as a requirement in Ofsted inspections would ensure that ESD stays on the agenda. However, the investigation concluded that to progress ESD, strong sustainable leaders should be sought through improved teacher training, continuing professional development and NGO support. The involvement of students and the local community are vital if ESD is to become more effective.

Introduction

Human consumption and steep population growth are over-taxing Earth's ability to support humanity's need for fresh water, clean air, mineral resources and food resources. The existing developed world's effect on the environment resulting in global warming, not only affects crops and livestock but biodiversity (Scott, 2007). If biodiversity is not preserved at natural levels, it affects ecosystems services: purification of air and water, decomposition and detoxification of our wastes and severe weather impact reduction. These and many more ecosystem services are crucial to sustain human life on earth (Jackson, 2008a).

As the effects of climate change, peak oil and population growth become more apparent (Hicks, 2010), the increasing need for Education for Sustainable Development (ESD) has been recognised (Scott, 2007; Sterling, 2009). The World Commission on Environment and Development calls for a change in human attitude that will depend on a vast campaign of education (UNESCO, 1987), partly to overcome climate change denial and scepticism (Monbiot, 2006). However, Hicks (2010) warns that the future is still largely a missing dimension in the secondary school curriculum. Studies have shown that the majority of schools exhibit a lack of awareness of sustainable development, and are inconsistent and uncoordinated in their teaching (Ofsted, 2008). Yet the coalition government no longer supports the National Framework for Sustainable Schools, has halted the closely related Building Schools for the Future and has cut the Green Talent Scheme which was to create five thousand green work experience placements (SEEd, 2010). More recently a government adviser has reviewed the curriculum and suggested that climate change no longer be included in the curriculum (Shepherd, 2011). These policy decisions have or will affect the way ESD is taught and supported in state secondary schools today, and in the future.

The purpose of the investigation was to determine strategies that could progress ESD in secondary schools. The investigation examined the policy decisions and support given by central and local government, reviewed secondary research and collected primary data by means of an online survey and interviews.

The investigation's key questions included:

i. should individual schools take responsibility for deciding if ESD should be included in the school curriculum, or should it be mandatory?
ii. were teachers equipped to teach ESD?
iii. were current external ESD schemes effective and how pivotal were non-government organisations (NGOs) to teaching ESD?
iv. who should drive ESD in schools?

Methodology

Questionnaire Study
Questionnaires were administered to a sample of teachers from schools within the London Borough Richmond Upon Thames (LBRUT). Eight schools were initially contacted but four were unable to participate. The sample group included teachers from Key Stage 3 and 4 (pupils aged 11 to 16) and from all subjects, enabling the investigation to compare data by subject. A total of 53 questionnaires were completed either online or by hand.

The questionnaire consisted of seventeen research-specific questions. Thirteen questions were quantitative multiple-choice questions: five of which offered an 'other' category so a none-specified option could be added, and three incorporated the Likert scale to help simplify the analysis of responses. Four questions were left open to allow the target group to give answers that the investigation may not have been aware of and to allow a more detailed explanation to be entered, providing qualitative data. Five additional questions captured personal and demographic data for analysis.

Smart-survey software was used to produce and operate the on-line questionnaire, and produce a summary of results. The data were analysed using contingency tables and significance was set at alpha of 0.05. All statistical analyses were done in SPSS (Ennos, 2007).

Qualitative Interviews

Participants who volunteered to attend an interview were asked to enter their contact details on the questionnaire so that they could be contacted. Four teachers agreed to an interview, however only two confirmed attendance. Additionally, a Head Teacher of a secondary school was interviewed. The interviews were recorded and notes taken. The interviews were semi-structured, guided by a schedule of questions but issues were explored as required. Interviewees were not led and their opinions were not taken out of context or sequence. Interviews lasted between twenty and thirty minutes.

In addition, meetings and correspondence were undertaken with central government including the Minister of State for Schools (Nick Gibb MP), Secretary of State, Department of Energy and Climate Change (Rt Hon Chris Huhne MP), Secretary of State for Business, Innovation and Skills (Rt Hon Vince Cable MP) and the Communications Unit, Department for Education.
Interview responses were grouped and then similarities and dissimilarities were noted. Themes, patterns and variations were highlighted and assessed for relevance.

Ethics and Confidentiality

The head of each school was contacted for permission to carry out the research. Participants were made aware by email that the survey was part of a degree research project and how the data would be used. The researcher's name and contact details were also included. Permission was sought from interviewees before interviews were recorded. Book tokens were offered as a school incentive, ensuring that the incentive had no direct affect on an individual's response. The deadline for entries was stated in the introductory email and book tokens were awarded promptly to the school with the most responses.

Confidentiality was achieved, as data provided by participants has not been presented in an identifiable form. A statement was included on the questionnaire explaining that responses would remain confidential and would be used for the purpose of an academic assignment.

Results

Eighty three percent of respondents were female, 17% were male compared to the national average of 62.5% female and 37.5% male (General Teaching Council for England, 2012). This may be because women were more likely to respond or it may reflect an unrepresentative gender distribution in LBRUT borough teachers as a whole. The results showed that there were no significant differences between the age profile of the respondent teachers compared to national teaching age profile (^{2} test for differences = 0.48, $p > 0.05$), indicating that with respect to age, respondents could be assumed to be representative of the national set of teachers.

Results indicated that the majority of teachers agreed ESD was an important subject, with 58% agreeing or strongly agreeing that ESD should be mandatory. Sixty four percent said it should be embedded in the National Curriculum. However, only 25% of teachers agreed or strongly agreed that ESD was a priority within their school. In addition, the majority of respondents (76%) felt they were not prepared to teach ESD during teacher training. There was no significant association between the date period teachers qualified and their view on how well they were prepared to teach ESD during their teacher training (2 test for association = 1.24, $p > 0.05$).

Nationally recognised ESD schemes appeared to have little impact on the schools and few respondents utilised non-governmental organisations (NGOs) to assist with teaching or ESD support (37.5% of those teaching ESD). Teaching and preparation time, lack of training and resources were cited as the biggest barriers to teaching ESD.

The vast majority of teachers felt that the management and teaching staff drove ESD, rather than government and local authority. Students were also an important driver, mentioned more frequently than the schools' head teachers. Teacher interviews raised a number of interesting viewpoints reflecting a number of themes that had already arisen in the quantitative analysis:

i. If climate change were removed from the National Curriculum teachers would not want to re-write lesson plans to reflect the change, so ESD would continue until new teaches took over, at which point it would slip off the lesson plan.
ii. As long as ESD was included in GCSE exams, it would be taught.
iii. NGO sustainable schemes only make a difference to students who are already interested in the subject.
iv. NGOs are a valuable source of information. They can bring real life examples from the field into the classroom, but they do need to be part of a developed scheme of work.
v. NGOs would be used more if they specifically covered National Curriculum topics and visited school to avoid cost and logistical difficulties.
vi. Lesson plans do not allow time for additional ESD to be taught, and only heads of the department would be able to instigate a change in teaching.
vii. The level of ESD taught is systematic of constraints in the curriculum. Academy schools are not constrained to follow the curriculum and so ESD will rely on the school ethos.
viii. To ensure ESD is taught, it has to be an Ofsted requirement, which needs to be followed by all schools.
ix. ESD schemes are an important reflection of the school ethos, but need to be assessed on pupil involvement based evidence.

A meeting and correspondence with central government raised the following points:

i. An emphasis by policy makers on school level responsibility. Thus the Minister of State for Schools (Nick Gibb MP) claimed the Government is committed to sustainable development, but believes schools perform better when they take responsibility for their own improvement.
ii. The aim of the National Curriculum review is to reduce it to reflect essential knowledge in key subjects, freeing up teachers to design a wider school curriculum. The Government fully expects teachers to tackle issues including climate change.
iii. Several research studies were cited by the Department for Education that were claimed to support government policies that schools perform better when they take responsibility for the day to day operation of sustainability.

The Local Government offices were contacted to establish their involvement in ESD. The Sustainable Schools Steering Group primarily work with Key Stage 1 and 2 and has very little to do with Key Stage 3 and 4.

Discussion

The investigation revealed that the majority of respondents had a firm belief in the importance of teaching ESD in Key Stage 3 and 4, however teachers did not feel prepared to incorporate ESD into their lessons, even if recently qualified. This supports previous research by Holden and Hicks (2007) who studied 442 secondary teacher trainees and also concluded that the majority realised the importance of ESD but felt they needed more guidance and knowledge before teaching the subject. This clearly indicates there is a lack of ESD training during teacher training and is supported by previous Ofsted (2008) research findings, indicating that there is an inconsistent, uncoordinated and limited promotion of sustainable development in schools. However, results from analysis of policy statements and qualitative data, strongly indicates governments abdication of responsibility believing schools should lead. There is a danger that ownership of ESD teaching thus falls between these two domains.

Predominantly teaching staff and management were believed to be the best drivers or potential drivers of ESD. Jackson's (2008b) research indicated that head teachers and then management were the most influential. Inline with the investigation, pupils were also perceived as having a high level of influence, which indicates that they need to be included in sustainable decision making, and reflects their interest and enthusiasm for the subject.

Sustainable leaders are acknowledged by many as one of the ways forward for ESD (Commonworks and WWF-UK, 2011; Jackson, 2008b; Ofsted, 2009; Scott, 2007). The government plans to utilise the National College for School Leadership to coordinate leaders for peer-to-peer learning in all areas including sustainable development. However, findings indicate that the majority of teachers today exhibit a lack of awareness of ESD, resulting in limited opportunities for peer-to-peer learning. NGOs appear to have limited influence or involvement in ESD within secondary schools, despite interviews indicating that they were a potentially useful resource. Funding and the logistical difficulties of organising visits to NGOs were cited as a barrier. Snell and Brooks-Wilson (2011) confirmed that NGOs could offer valuable ESD support. Organisations such as Commonworks and the WWF have recognised the benefits of teacher training, not just expanding ESD knowledge but demonstrating how to be sustainable leader. This has been achieved by developing a conceptual understanding of ecological and social systems, helping teachers to understand the interconnection between current global challenges (Commonworks and WWF-UK, 2011). ESD needs championing by leaders who will not only work within the school but in partnership with the local community, relating to global sustainable issues (Scott, 2007; Commonworks and WWF-UK, 2011). This would help create the leaders the Government requires for peer-to-peer learning.

In addition Ofsted (2009) believe that such sustainable leaders are typically effective in the field of general school improvements. Distributed leadership is the most effective method of fostering ESD in schools, involving different members of the school community, embedding sustainability across all aspects of the school (Jackson 2008b). The interview data indicated the potential importance of including ESD in Ofsted inspections as a means of keeping ESD on the agenda. Inclusion of ESD in the National Curriculum would not be as effective, as the growing numbers of Academies are not required to follow the curriculum, and inclusions in exams is not inclusive, as only able students would engage in the subject.

The value of nationally recognised ESD schemes, however, appears questionable as results suggest that teachers are not entirely aware of which schemes their schools are involved in. The vast majority of teachers stated they had not undertaken any additional activities as a result of registering with a scheme.

Inevitably, the study had a number of limitations. As the level of response from teachers was low, it would perhaps have been better to extend the survey beyond the borough, so that quantitative and qualitative data was more significant. In addition, pupils in the LBRUT attain higher qualification levels than the national average, and overall employment is higher. The likely implication of sampling bias in this study is that it underestimates how poorly embedded ESD actually is within secondary schools nationally.

Conclusion

Teachers are clearly invested in ESD but evidence suggests that they are not fully supported to deliver. Yet government policy places heavy emphasis on the roles of individual schools to lead. Including sustainability as a requirement in Ofsted inspections would ensure that ESD stays on the agenda. However, the investigation concluded that to progress ESD, strong sustainable leaders should be sought through improved teacher training, continuing professional development and NGO support. The involvement of students and the local community are vital if ESD is to become more effective.

Further Research

There is a growth in external ESD schemes. However, more evidence is still needed to show how schools react and adjust as a result of the schemes, to determine if they currently have any true value. The impact of various leadership training strategies also needs further research, to gauge which are the most effective: training during teacher training, NGO training or continuing professional development by peers.

Reference List

Commonwork and WWF-UK (2011) *Leading for the Future*. Edenbridge: Commonwork.

Ennos, R. (2007) *Statistical and Data Handling Skills in Biology*. 2nd edn. Harlow: Pearson Education Ltd.

General Teaching Council for England (2012) *Annual digest of statistics 2010-11 – Profiles of registered teachers in England* [Online] Available at: www.gtce.org.uk/documents/publicationpdfs/annual_digest_psd110811.pdf (Accessed: 28 January 2012).

Hicks, D. (2010) 'The Long Transition: Educating for optimism and hope in troubled times', *UK ITE Network for Education Sustainable Development/Global Citizenship, Third Annual Conference*. London South Bank University, London 15 July. London: Centre for Cross Curricular Initiatives.

Holden, C. and Hicks, D. (2007). Making global connections: the knowledge, understanding and motivation of trainee teachers. *Teaching and Teacher Education*, Vol.23, pp.13-23.

Jackson, R.B. (2008a) 'Conservation Biology and Restoration Ecology', in Campbell, N. A., Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R. B. (eds.) *Biology*. 8th edn. San Francisco: Pearson Benjamin Cummings, pp.1245-1267.

Jackson, L. (2008b) *Leading Sustainable Schools*. Nottingham: National College for School Leadership.

Monbiot, G. (2006) *Heat – How to Stop the Planet Burning*. London: Penguin.

Ofsted (2008) *Schools and Sustainability.* Manchester: Ofsted (HM 070173).

Ofsted (2009) *Education for Sustainable Development: Improving Schools, Improving Lives*, ref no. 090004. Available at: http://www.ofsted.gov.uk/resources (Accessed: 30 January 2012).

SEEd [Sustainability and Environment Education] (2010) *Sustainable Schools*. Available at: www.se-ed.co.uk/sustainable-schools (Accessed: 2 August 2011).

Scott, W. (2007) *Raising Standards: Making sense of the sustainable schools agenda*. London: Specialist Schools and Academies Trust.

Shepherd, J. (2011) 'Climate change should be excluded from curriculum', *Guardian*. 12 June [Online]. Available at: www.guardian.co.uk/education/2011/jun/12/climate-change-curriculum-government-adviser (Accessed: 13 June 2011).

Snell, C. and Brooks-Wilson, S. (2011) 'Education for Sustainable Development under the Coalitions Government?', *Social Policy Association Annual Conference 2011*. University of Lincoln, Lincoln 4-7 July. York: Department of Social Policy and Social Work, University of York.

Sterling, S. (2009) *Sustainable Education – Re-visioning Learning and Change*. Totnes: Green Books.

UNESCO (1987) 'Man and the Biosphere: a partnership for sustainable development', *The Courier,* October. Paris: United Nations Educational, Scientific and Cultural Organization.

Guidelines for Contributors

Submissions are welcome from primary, secondary and higher education sectors. Contributions are encouraged from any country and it is expected that the Journal will publish articles that offer readers insightful, inspirational as well as practical information about teaching, learning and assessment across the curriculum.

The normal word limit for articles is 3000 words although up to 5000 words will be permitted in exceptional circumstances. We would welcome the opportunity to publish articles that describe good practice in schools, literature reviews that increase understanding of particular educational domains, research articles that explore new ideas, and articles from practitioners that demonstrate the contribution that reflective practice and informed action can make to effective teaching.

Articles for consideration by the Editorial Board should be emailed to christine.edwards-leis@smuc.ac.uk. Detailed notes on the preparation of articles are provided at the end of these guidelines.

The articles will be 'blind' refereed by referees, who will remain anonymous and authors will receive feedback through the editor.

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Developing Research Assignments For Submission

Many teachers and students write assignments that include literature reviews or that report on inquiries into aspects of their practice undertaken in a range of settings. These pieces of writing could be considered for submission. Ensure you provide an abstract and key words and reference according to the Harvard Method of Referencing.

Notes For Research Articles For Submission

It is expected that research articles make an original contribution to education research. They should be based on evidence such as newly acquired data through empirical research, historical data, or published work.

Sharing Good Practice And School Projects

Great things happen in schools. Teachers and head teachers are encouraged to share their practice with the education community through descriptions of projects that they have created, implemented and evaluated. While these pieces are not necessarily expected to be supported by evidence from the literature (as a research article would be) the theories that underpin the practices described should be included to demonstrate informed pedagogy.

Preparation of articles

Title
Please write a succinct title and include author/s, affiliations and email address of lead author.

Abstract
An abstract should be 200-250 words. It should have 6 key words for reference purposes. The abstract should provide the argument put forward, a rationale for the research, method used and major findings/recommendations. A good practice abstract will include an explanation of the project (length, participants, curriculum focus), its purpose and pertinent outcomes

Article format
The article should include the abstract, all figures, tables, and reference list. Do not include a bibliography. It should be typed on A4 portrait in Word and pages should be numbered. Use Times New Roman (or similar serif font) 11pt font typeface. Headings for each section are recommended to guide the reader. Avoid footnotes and endnotes unless essential to clear communication. All figures and tables must be numbered and labelled and be on separate pages rather than embedded in the text. Indicate where they are to be inserted. Avoid grey or coloured shading on graphs. If photographs are to be included then ensure that you have both ethical approval for publication (this is particularly necessary for children) and copyright approval. All photographs should be high resolution.

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The article is to be referenced and the Reference List compiled using Harvard Method of Referencing.

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