# New Perspectives for Learning

Insights from European Union funded Research on Education and Training

Issue Four
January 2003




**Improving Schools Issue**

This newsletter is the fourth in a series of occasional issues highlighting for policy and decision makers, some of the key conclusions and recommendations of projects conducted under the EU Targeted Social Economic Research (TSER) Programme and under the Key Action "Improving the Socio-economic Knowledge Base".


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# Fostering innovations in Science Teaching

There is continuing concern about how to foster greater scientific literacy particularly amongst secondary school children. However, challenging new ways of teaching and learning are now becoming available to teachers of science education due to new results from recent research and the additional technological resources that are now available. The findings of research are contributing to a change in the role of teachers with regard to content and teaching/learning processes and methods. However, these changes can only be implemented when teachers feel happy about adopting them.

*"changes can only be implemented when teachers feel happy about adopting them"*

One project has focused on understanding the conditions that may enable curricular innovations to be transformed into successful implementations by science teachers. At secondary school level the project studied the implementation of informatic tools (for modelling, simulation and for real-time experiments); the implementation and use of specific images; and the implementation of innovative teaching practices. Observing experienced science teachers in real classroom situations the project focused on schools in France, Italy, Norway, Spain, and the United Kingdom.

A number of general conclusions were reached by the project. It was found that the introduction and embedding of didactic innovations into the school system is a complex process requiring the innovations to be flexible, but robust, in order to ensure that the intentions of a designed

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## Editorial
### Learning from Research

When developing future policy, implementation and intervention strategies in education and training, consideration should always take into account lessons learnt from research conducted in this area. Equally so, it is important that research results are feedback to policy-makers and in a way the recommendations can be acted upon. This has not always been the case, but since the Lisbon summit, the Commission is working to strengthen the links between education and research.

The year 2003 starts with much thinking about future European research activities and intervention programmes in the area of learning and the knowledge-based society. The European Commission's DG for Education and Culture has recently issued a public consultation document on "The future development of the European Union Education, Training and Youth Programmes after 2006". As part of the 6th Framework Programme the DG for Research has recently launched a new call in the area of the "Knowledge-based Society and Social Cohesion". Now is the time to build upon recently completed and ongoing research activities.

This issue highlights some key results and recommendations from research projects that could be considered as being important for improving schools. This European research was conducted under the *Targeted Socio-Economic Research* (TSER) Programme of the Fourth Framework Programme and the Key Action

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*Improving the Socio-Economic Knowledge Base* of the Fifth Framework Programme that support European researchers in the social sciences and humanities and includes research on education and training issues. The transition from education to work, immigration, social exclusion, educational change, education governance, funding learning and new methods for education and training are some of the activities that have and are being addressed by the research projects and thematic networks.

This newsletter describes completed and ongoing European research that could help policy and decision makers better understand issues relating to improving the mechanisms for learning across different levels of the education system.

## Contents



**A full list of Briefing papers and details of ongoing projects can be found at: -**
**http://www.pjb.co.uk/npl/index.htm**

## Investment in Schools

Improved schooling and training has long been considered as a way of improving the work force and strengthening the labour market. This project has brought together the work and experience of European economists who have contributed to fifty-seven working papers. This has enabled a comparative analysis and a deeper understanding of the mechanisms that have shaped schooling and training systems and labour market transitions, somewhat differently across countries.

***"all schooling systems are subject to market forces"***

It was considered that generally, all schooling systems are subject to market forces i.e. as the school population increases more resources are put into the system. However the way in which resources are allocated within schools is as important as differences in resourcing levels across schools or school districts. A low pupil-teacher ratio significantly increases the unit cost of education, as does early streaming and decentralisation. Since a higher pupil-teacher ratio compensates for the increased cost of streaming, differentiated education systems allow more crowded classrooms in order to maintain the unit cost of education at the same level as that in non-differentiated systems. Higher resources in the form of early streaming or a lower pupil-teacher ratio do raise the unit costs of education but also seem to increase the academic attainment of pupils.

There was also some evidence to suggest that since ability can be detected earlier than talents, it is not optimal to make an intensive use of differentiation by cognitive ability too early at the lower secondary level. There also seems to be a trade-off between differentiation in schools and selection at university entry level. The use of selection at university is reduced essentially by the amount of differentiation at the upper secondary level, the quality of secondary education, and the typical duration of study in universities.

**Further information: -**

Project Title: *"Schooling, Training and Transitions: An Economic Perspective"* (March 2000)

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# A Comprehensive Framework for Effective School Improvement

Effective school improvement is high on the agenda of most countries' educational policies. However, theory and research associated with this have tended to come from the paradigms of "school effectiveness" and "school improvement" that have grown apart over the years in terms of their methodology and focus.

School effectiveness is strongly focusing on student outcomes and the characteristics of schools and classrooms that are associated with these outcomes without automatically looking at the processes that are needed to bring changes. School improvement is mainly concerned about changing the quality of teachers and schools without automatically looking at the consequences for student outcomes. In short, school effectiveness is trying to find out *what* is to be changed in schools in order to become more effective while school improvement is trying to find out *how* schools can change in order to improve.

This project has aimed to create stronger links between these two ways of thinking by the creation of a "comprehensive framework" for effective school improvement that helps to explain why improvement efforts succeed or fail and which factors promote or hinder effective school improvement. The project conducted an extensive analysis of about 30 school improvement projects in eight countries - The Netherlands, Finland, United Kingdom, Belgium-French Community, Greece, Italy, Spain, and Portugal.

The key outcome was the Effective School Improvement (ESI) framework based on the theoretical and practical analysis of school improvement projects. The school is put at the centre of this framework that can be used by: -

*Practitioners* - for designing, planning and implementation of school improvement.

*Researchers* - for further research in the field of effective school improvement.

*Policy makers* - as it helps to clarify which factors must be taken into consideration in the planning of improvement processes in schools. However, they must be aware that the framework can never be used as a recipe for effective school improvement or as a ready-made toolbox for the implementation of improvement in schools.

Helped by this framework the project reached a number of conclusions. It was considered that schools and school improvements must always be within the educational context of a country. Even if an improving school is free to decide about their improvement outcomes they will always have to be in line with the wider educational country context which exert influence through pressure to improve, resources for improvement and educational goals.

*"school improvements must be considered within the educational context of each country"*

Effective school improvement requires whole school processes aiming to enhance the quality of instruction in classrooms. Individual teachers can never promote lasting changes in the school. The school organisation may add or subtract value to that of its individual members.

Schools with little team collaboration might expect to find a large variation in the performance of pupils. However, in a well-led and managed school there is likely to be less variation and greater consistency across the school. This results in the "school effect" - adding value to that of individual teachers.

However, in most countries studied, the school, as an organisation does not currently play a major role in effective school improvement. Most current practice seems to target teachers as important for influencing effective school improvements. However, teachers tend to work independently, perhaps without a school plan of common goals and methods. Inspectors assess only teachers not the schools. Teachers are placed centrally at schools, which might reduce their involvement in school improvement. The principal's main function tends to be administration rather than fostering educational

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***"Effective school improvement requires whole school processes"***

***"Individual teachers can never promote lasting changes in the school"***

***"the school organisation may add or subtract value to that of its individual members"***

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leadership and may be elected for a short time period, thus reducing their central role in managing school reform.

However, in some countries there is evidence to point to the importance of the school as an organisation. Use is made of effective school knowledge - by making schools accountable for inspection results that are published in newspapers and the Internet. The development of schools as "learning organisations" is fostered by example, peer coaching, team staff development and schools receiving earmarked funds for staff development.

***"use is made of effective school knowledge - by making schools accountable for inspection results that are published in newspapers and the Internet"***

It was found that schools do need some form of external pressure from the educational context to start improving. Four types of pressure were distinguished: -

*Market mechanisms* - competition between schools - leading to consumers (parents) being better informed about the schools' quality. However, it can result in parents' preference for traditional schools, the creation of white and black schools and inequality between schools.

*External evaluation and accountability* - generally concerns the measurement of student outcomes with a national validated test. When the results are published schools are held accountable and are under pressure to positively change student outcomes. However, this can lead to negative consequences like helping students with the tests. If sanctions are high, schools can be closed down. But, sometimes evaluations may not be fair.

***"society influences schools in many ways and demands school improvement that is often mediated by government policies responding to influences"***

**Further information: -**

Project Title: *"Capacity for Change and Adaptation of Schools in the Case of Effective School Improvement"* (July 2001)

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*External agents* - such as inspectors, policy makers, educational consultants and researchers may push schools to improve by giving suggestions of what and how to improve.

*Participation of society in education and societal changes* - society influences schools in many ways and demands school improvement that is often mediated by government policies responding to influences like learning to learn how to study and the use of information technology. Sometimes these changes are receiving wide support, but there is a limit to the amount of changes schools are willing to perform.

Material and non-material forms of support are essential for effective school improvement. Three forms of support were identified: -

*Granting autonomy to schools* - this could be in the form of educational goals, educational means, organisation (personnel, management, administration) and finances. For effective school improvement some autonomy is necessary because improvements, which do not tailor to school's needs, are likely to fail. The success of autonomy depends to a large extent on the willingness and capacity of the school team to continuously improve in the direction of a more effective school. Some forms of external control seem to be a requirement to stimulate schools to use their autonomy in a 'good' way.

*Financial resources and working conditions* - with sufficient financial resources and time, improvement will succeed more easily. Large classes, a large amount of teaching hours and instability of education policies do not contribute to the motivation to improve.

*Local support* - from parents, district officials, school administrations, and school boards.

The project recommended that efforts should be made to reduce the negative aspects of market mechanisms. External evaluations should take place at regular periods. The results should be presented in a fair way in order to show what value has been added since the last evaluation. But, the information collected should be primarily aimed at helping school improvement. It also considered that high quality external agents should be used as facilitators of effective school improvement but care is needed not to overload schools with innovations.

# Thematic Network on Problem Solving and Assessment Tools

Substantial scientific improvements have been made in the field of student outcome indicators over the years. However, the focus of these studies has been limited to the traditional assessment domains of reading, mathematics and science. Due to rapid technological and social changes there is a growing demand for competencies beyond these traditional domains, such as problem solving, communication skills, and learning to learn. This project, which developed a thematic network of European expertise to specifically address cross-curricular competencies in the area of problem solving and tools for assessment is making a major contribution to worldwide initiatives like that of the OECD, in order to gain a better understanding of the processes of problem solving and how it may be assessed for comparative purposes.

The project concluded that from the societal as well as from the educational perspective, problem solving could be seen as a cross-curricular competence. However, scientific research into problem solving has until recently tended to be conducted from a psychological perspective with little attention being paid to the assessment of problem solving for large scale comparative purposes. This has resulted in a gap emerging between developing theory on thinking and problem solving and ways of measuring problem solving for assessment purposes.

However, there now appears to be agreement that problem solving is a cognitive process with several stages in which a person uses their working, short term and long term memory. But, there is still debate on whether problem solving is a domain specific competence or a general competence; or whether a problem for measuring problem solving should be simple or complex.

It is now considered that problem solving is a competence needed in daily life problem situations and needs to be measured. Instruments that measure problem solving, as cross-curricular competences for large-scale assessment are starting to emerge. But, instruments to measure problem solving still need to be modified or adapted for large-scale comparative studies. The use of technology raises new opportunities in the assessment of skills and competencies, compared to current paper-pencil based methods. In fact, the dynamic aspects of problem solving cannot be grasped without technological support.

The project recommended that there is still a need to develop new assessment tools that measure general problem solving competences and that further research should be conducted into technology-based assessment methods of problem solving including the use of simulations, video, computer networking and virtual reality.

***"there is a gap emerging between developing theory on thinking and problem solving and ways of measuring problem solving for assessment purposes"***

***"further research should be conducted into technology-based assessment methods of problem solving"***

**Further information: -**

Project Title: *"New Assessment Tools for Cross-Curricular- Competencies in the Domain of Problem Solving"* (1999)

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# Early learning: the Impact of Environmental Factors

*"there is a widely held belief that early experiences have an important effect on developmental outcomes during pre-school and primary school phases"*

There is a widely held belief that early experiences have an important effect on developmental outcomes during pre-school and primary school phases. In order to gain a better understanding of how different factors affect children's development, research has been conducted into the organised programmes for the care and education of young children prior to the time they are enrolled in the primary school system in Austria, Germany, Portugal and Spain. These various programmes and activities have been collectively called the "Early Childhood Programme".

This project consisted of two studies. The first study focused on 4 year olds in their pre-school and their home environment and aimed to get a better understanding of the nature and quality of care and how it affects the children's developmental outcomes. A second study, excluding the Portuguese children, looked at the same children as 8 year olds, when they had moved up to primary school.

The project made a number of comparative observations and drew a number of conclusions based on the factors that can affect child development at pre-school and on entry to primary school. It then recommended policy makers should recognise that school success is highly dependent on high quality practises in both the Early Childhood Programmes and the primary school education systems. These practises can be flexible if they provide relevant education of a consistently high quality. But, emphasis needs to be placed on the inclusion of the 10-15% of children who struggle with transition into primary school. This needs to be implemented by a combination of in-school measures and better parent-school co-operation.

*"school success is highly dependent on high quality practises in both the early childhood programmes and the primary school"*

As Early Childhood Programmes are an important support system for children's development in the pre-school phase and school success in primary schools they require a solid financial basis and well-trained professionals operating within an appropriate efficient and support framework, to utilise their full educational potential.

Children need the opportunity, time and a variety of materials that allow different ways of learning. A sufficient amount of instruction hours needs to be included in the first grades of primary schooling, with a sufficient number and variety of materials available to children and teachers.

Teachers should be made more aware of the benefits of good classroom management as children need sufficient time for contextualised learning, with the chance to both apply and transfer their learning. Close co-operation between parents and teachers needs to be regarded as an important element of successful primary schooling.

Strengthening the educational resources available to all families is a very important task. Therefore the development of education-related conditions and resources in families should be the primary goal of family-support measures. Support for families should be initiated before a child's birth and should be a process that accompanies the growth of a child, at least until the child has made the transition into primary schooling. This should ensure that a close relationship between families and their primary schools is established. Although parent-education does exist it could be extended with incentives to encourage parent's co-operation in such programmes.

Finally, the project recommended that future research into the educational quality experienced by children in their various settings needs to continue to provide better information for policy makers, administrators and practitioners to make crucial improvements.

**Further information: -**

Project Title: *"European Child Care and Education Study"* (1999)

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# Cost of Labwork

The cost of "labwork" experiments tends to be an expensive component of science education across Europe. This project examined the effectiveness of labwork and developed approaches designed to promote more effective teaching and learning outcomes. It focused on the use of labwork in teaching physics, chemistry and biology to students in academic science streams, in upper secondary schooling and the first two years of undergraduate study.

It recommended that labwork should address a broader range of learning objectives than currently addressed. In particular, labwork rarely addresses epistemological objectives and teachers rarely make these objectives explicit when designing labwork activities, sequences of labwork or labwork sheets. Similarly, conceptual objectives, procedures to be learnt, data collection and processing are generally left implicit in the design of labwork. There is also a need to improve the design of assessment along side the design of more effective targeted labwork.

Therefore, improvements to labwork practices need to be addressed at teacher education level with more collaboration between European researchers, teachers and policy-makers being one of the key aims of research in science education over the next few years.

**Further information: -**

Project Title: *"Improving Science Education: issues and research on innovative empirical and computer-based approaches to labwork in Europe"* (1998)

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Specific recommendations were made relating to the use of images:

1) Teachers should be trained about the grammar of visual language so that their drawings, schemes, graphs and diagrams convey the ideas and concepts that they desire.

2) Students and teachers should have specific training in the use of real-time graphs produced in experiments based on computer driven sensors. The optimisation of an image's readability and the interpretation of the unique features of real-time graphs, including artefacts, should be particularly addressed.

3) Authors and designers of images should collaborate with curriculum (didactic) experts to optimise the suitability of images and concepts according the level of students' understanding.

Specific recommendations were also made relating to the use of information technology (IT) tools:

1) Training should consider that the use of IT in science is still 'fragile' and 'patchy', even though this situation is changing rapidly.

2) Attention should be focused on the new opportunities created by the use of IT in science courses. IT-based "real-time experiments" saves time in capturing data during labwork, and allows more time for students to analyse different variables and for the rapid repetition of experiments.

3) However, claims that IT helps deepen understanding need to be backed up with specific examples of classroom activities and an analysis of the benefits that are felt to be associated with them.

4) Training should aim at creating clusters of teachers in each school in order to diffuse expertise among fellow teachers and potentially greatly increase the take-up of innovations based on IT.

***"teachers should be trained about the grammar of visual language"***

***"authors and designers of images should collaborate with curriculum (didactic) experts"***

***"labwork should address a broader range of learning objectives than currently addressed"***

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innovation are shared by teachers, who have to proactively implement them. It was found that didactic innovations go through a "metabolic process", that may be long, before they are fully "naturalised" i.e. thought and used as natural and appropriate strategies/tools for teaching/learning. Internalising innovative approaches entails broad acceptance of their rationale by teachers and implementing them in different contexts and situations in line with their intentions.

*"many teachers have very little experience in the use of information technology tools"*

Relating to the use of information technology tools it was found that only a few teachers have a lot of experience in using computers and many teachers have very little experience at all. It was also found that there is still a lot of uncertainly about the role of the computer as an integral part of education. However, in all the countries studied, there are policies to develop computing in schools, but there are substantial differences in the actual provision of computers. Generic software seems to prevail with word processing packages used the most, followed by spreadsheets. Simulations are strongly used by only a few teachers. Generally they are not used at all yet. But, modelling tools are rarely used despite some very strong arguments in favour of their importance.

*"the development of the information society is creating a culture in which images acquire a higher profile as a way of communication"*

The project also gave consideration to the use of images in science teaching, particularly as the development of the information society is creating a culture in which images acquire a higher profile as a way of communication. It is important to know which features of an image cause a student to have difficulty in interpreting the image. It was found that students tend to make narrative readings of the images, to interpret them as if they had a story-like structure giving excessive relevance to elements (like arrows) or compositional structures (as left to right arrangement) that result in getting the wrong meaning. Unfortunately, teachers' awareness of students' difficulties reading images is not always very high. When presented with documents (images and text) that do not include all the information needed to interpret them, students often resort to interpreting mechanisms in a way that shows a lack of scientific background and/or insufficient knowledge of the visual language. These mis-readings were observed when critical information is missing from a document.

*"teachers' awareness of students' difficulties reading images is not always very high"*

The project made the following key general recommendations: -

1) Teachers need support and positive assistance in coping with the transfer of innovations into actual class-work in the form of appropriate teacher training where it is explicitly and extensively explained using real examples why the "old" approaches need to be avoided, modified or integrated with the "new".

2) A special focus is needed on increasing teachers' awareness about careful planning of the cognitive dimensions of class activities as well as of their practical aspects.

3) Training should extensively explain and show the need to be extremely careful with all types of language used. Care is needed in drawing, reading and interpreting graphs, schemas and diagrams. It is necessary to be able to express scientific terms in everyday language, as well, to correctly use the scientific language in the scientific domain. To cross both domains has been detected as difficult for teachers as well as for students. Therefore, an analysis of the understanding of new scientific concepts and words should be carried out in order to verify their correct usage.

4) There should also be analysis of existing teaching materials (texts, images, activities and worksheets) in order to avoid needless misunderstanding or misleading of the concepts.

5) Special attention should be paid to encourage students to interact verbally with peers about the tasks and activities proposed, in order to improve understanding and learning.

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**Further information: -**

Project Title: *"Science Teacher Training in an Information Society"* (April 2001)

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