Evaluating Interdisciplinary Teaching of Art and Science

Ivor Hickey, Deirdre Robson
St. Mary's University College (United Kingdom)
d.robson@smucb.ac.uk

Abstract

This paper describes the justification for and the results obtained from implementing a novel approach to teaching and learning in which art and science are integrated in thematic teaching for both late primary and early secondary school classes. Both subjects are given equal status in this approach. One aim being to demonstrate the importance of creativity in science education and factual knowledge in art through this methodology rich in transferrable skills. Another was to allow pupils a greater degree of input into the organisation of the learning process.

In the primary phase of the research 22 schools from the UK and Ireland were studied. All schools worked on the theme of 'flight'. Responses were obtained from head teachers, class teachers, parents and children. All groups found the approach to be advantageous and to stimulate learning. Teachers and school heads reported that learning in the two specific areas of art and science was greatly enhanced. In addition, transferable skill development of learners was strongly promoted. One unpredicted outcome was that teachers found that linking art and science in a theme had significant positive effects on children's literacy attainment. Combining art and science was found to support children who previously showed little enthusiasm for schoolwork, while allowing gifted children to reach higher levels. Parents were very supportive of the approach and reported that children were very motivated and engaged their families in the area of study.

The secondary phase was conducted in six schools in the UK. Here schools were free to select their own topic and these ranged from life underwater to design of clothing for astronauts. Schools structured the interaction between subjects in different ways tailored to suit their individual circumstances. Again feedback from teachers and heads was very positive in relation to both learning and development of transferrable skills and creativity. Teachers enjoyed the aspects of co-teaching across subject disciplines. They were surprised by the degree of engagement that pupils displayed when exposed to this type of teaching.

Strong parallels between the positive outcomes to this approach were noted in both educational phases. However, it was clear that secondary schools had more difficulty in obtaining optimal outcomes. A number of factors caused problems for these schools. Important among these were, examination preparation for other more senior classes, timetabling difficulties, lack of adequate information transfer between teachers. Schools that succeeded best used individual pairs of teachers for the project rather than working at departmental level and were able to introduce elements of flexibility in their timetables

We conclude that interdisciplinary teaching of art and science is a potentially useful tool in engaging learners and promoting transferrable skills and in particular, literacy. It may be particularly useful in dealing with the drop in academic attainment that is frequently observed in the transition between primary and secondary education, but only where schools have the creative capacity to adapt their structures appropriately.

1. Introduction

Interdisciplinary learning supports teachers who wish to move away from excessive emphasis on knowledge-based aspects of school curricula and prefer to concentrate on the development of those transferrable skills that promote employability in learners whilst not sacrificing subject understanding. Having to deal with more than a single subject in lessons forces both teacher and learner to have a deeper appreciation of what they are studying and prevents either party from taking a 'learn by rote' approach. We report here on a number of initiatives in upper primary and lower phase secondary schools where art and science have been linked in studies of specific topics.

Interdisciplinary learning is a well researched topic and is considered to have multiple advantages for learners. These include:

- Boundaries between disciplines dissolve.

- Constructivist approach.
- Experiential learning.
- Theme or question at the centre.
- Student choice.
- Embedded transferable skills.
- Disciplines connected by common concepts and skills.
- Teacher's role as facilitator.
- Increased creativity from teachers and learners.
- Methods used which engage all children.
- Culminating activity that integrates disciplines taught.
- Accountability and assessment.

(Adapted from [1])
The value of interdisciplinary learning has become recognised in several modern curricula such as the Curriculum for Excellence [2] in Scotland and other European countries such as Denmark [3]. In Ireland [4][5] it is seen to have a role in primary but not post-primary education. However, many jurisdictions still hold strongly to the teaching of individual subjects at all levels of their education programme. At the same time the importance of transferrable skills and creativity in the production of an effective workforce is widely championed across Western Europe. We would argue that integrating teaching of curricular subjects can make a major contribution to this without reducing subject knowledge.
In our study we chose to integrate art and science in the classroom. At first sight these may seem unlikely to fit well together as they represent apparent extremes of expressive and rational human activities. However, the two work well together as was clearly seen by teachers and pupils involved in the research projects. One reason for this is that throughout the research we emphasised experiential learning where children responded to intellectual stimuli, taking on the roles of artists and scientists as opposed to merely accumulating facts and skills as is often practised in schools.
The two subjects were then seen as dynamic and the integration between them was based on the commonalities we identified in the work of artists and scientists. These include, topics of study; gathering of information; developing ideas, experimenting, visualising; creative thinking; problem solving and so forth. This differs from cross-curricular teaching where tenuous connections between subjects are used to develop a common theme. Examples are often found using historical topics such as the Vikings or Egyptians, and although this may aid understanding of history it does little to awaken children's wider learning potential.
Our interdisciplinary approach was underpinned by two key factors. Firstly, art and science were seen as equal partners and secondly the experiential aspect of learning meant that teachers could not plan the whole series of lessons from the start. Children's ideas became an important part of the planning and teachers had to be more creative in how they organised lessons.

Methods

Both primary and post-primary pilots were preceded by prior field testing of the methodology. In the research with primary we tested the system in four local primary schools before working with 18 schools from the United Kingdom and Ireland in the main pilot. For post-primary we field tested with the entire first year intake of a single local post-primary school before working with five schools in the main pilot.
The primary pilot began with two days of training for the two teachers involved in each school and also for one member of the school management team. All schools were asked to work on the theme of 'Flight'. Schools were allowed to run the project in what ever way fitted best with their own organisation, but it was agreed that it would last for approximately eight weeks with children from the later phase of primary education. Each school was supplied with an identical set of resources and funds were given for educational visits and to invite relevant experts to visit the schools. The post-primary pilot had similar pre-operational training, but this included sessions on co-teaching as it was intended that teachers of both art and science would be able to teach joint classes. The secondary schools were not given a specific topic and hence were not supplied with resources. Funding was supplied to cover expenditure on resources, educational visits and involvement of experts.

All schools were visited on at least two occasions during the research by researchers and separate visits were made by external evaluators. It was decided that our criteria for assessment of the work would be teachers' and school heads' professional opinions, rather than any form of before-and-after testing of classes as the effect of a test is likely to skew results and encourage teachers to 'teach to the test'. The following data were gathered. Head Teachers, teachers and parents were all surveyed by questionnaire. Pupils' responses were obtained through focus groups. Teachers also supplied journals that they kept during the project.

Results

The Primary Pilot

The primary research pilot was known as 'The Leonardo Effect'. Children were tasked to create a flying creature, which could reflect any aspects of biological and/or mechanical flight. The work began with a Gathering of Information stage where children obtained as much information about the topic of flight as possible. This included using traditional school resources, but also included trips to centres of interest, visits from experts and firsthand experiences. Working with the children teachers were able to focus their research into specific areas of interest in a Developing of Ideas stage, which led in turn to the Creative stage in which the children applied their knowledge and creative ideas to design and construct a creature. Choices made during its design had to be justified. Finally, an optional final stage of Extension was available where the information and skills accumulated were used in different ways such as play writing and producing animations.

A brief synopsis of results will be given here but more detailed and quantitative information has been published elsewhere [6].

26 teachers responded through questionnaires and all were positive about the impact integrating art and science had with their children. Specific areas of teaching were looked at and teachers were most positive when it came to the effect on children's learning, development of transferrable skills and literacy. The very positive effect on children's literacy was thought to come from the stimulus the approach had given and children felt the need to communicate their ideas and findings. Significantly, several teachers also reported that the approach used had strongly influenced children who had previously been regarded as disaffected learners.

School heads were equally enthusiastic. They were unanimous in stating that the pilot had left a positive legacy in their schools and would support its application as national policy. They also noted the effect it had on stimulating creativity amongst both teachers and students. They did however note that staff development would be needed and some recently trained teachers may find it difficult to adapt to a less structured teaching regime.

Parents were surveyed using a short questionnaire. We were surprised to see how supportive they were as we felt many might have favoured a rigid school environment where mathematics and literacy classes dominated. However, many parents noted how the 'flight project' had stimulated their children and commented on how they now felt more in touch with what happened at school.

When asked, the children gave us some interesting insights into the study. Apart from enjoying the opportunity to be more involved in deciding the way they approach a topic we found that they were suggesting a number of exciting topics that their school could cover in the same way.

The Secondary Pilot

There is evidence that performance of learners dips following the transfer from primary to Post-primary education. We decided to apply the lessons we had learned from the Leonardo Effect study in primary schools to 11-14 year old pupils in post-primary education. This research project was known as 'SCIART'. Although we were dealing with children who are often only one or two years older than in the Leonardo Effect their learning environment and its organisation was radically different. As well as making learning more involved for the learner this structure necessitates the development of complex timetables and reduces interaction between teachers in different departments. In summary we found that the majority of teachers found that SCIART had benefited both art and science learning, but more importantly had proved a major stimulus for the delivery of transferrable skills and development of creative teaching that engaged more learners. Teachers were very supportive of working together across subjects and found that students seemed to enjoy this classroom approach. Teachers commented on the increased level of research that students were undertaking when taught through

SCIART and this correlated well with development of literacy, but only one school was able to involve a specific literacy teacher in the process.

Post-primary teachers encountered much greater problems in delivering SCIART than their primary counterparts had. They cited difficulties in making time for meetings with colleagues in other departments; keeping all teachers informed and the pressure on time caused by important examinations for students in senior classes as major problems. The timetable itself caused some schools problems as it proved impossible to time the relevant science and art classes close together. It was significant that several teachers found that events held 'off-timetable' such as field trips and information gathering days with experts were most beneficial to their students.

Reviewing the data it was clear that the most positive results had been in schools where pairs of art and science teachers had worked together rather than where the interaction had been at departmental level. One school had a reduced number of teachers for their first year students and this also assisted innovative teaching.

All the head teachers involved agreed that there was merit in the introduction of the SCIART approach in their schools. In particular they appreciated the opportunity it provided for teachers to engage in more creative teaching practices and saw how this, in turn, impacted on pupils. Like their primary counterparts they were also aware that this sort of innovation would require considerable staff training.

Conclusion

It is clear to us that in the primary phase the integration of art and science in the manner undertaken in the Leonardo Effect pilot is beneficial to both pupils and teachers. It is relatively easy to implement although some retraining of teachers is necessary. In early post-primary education there are again clear benefits from the integration of art and science. Unsurprisingly, the nature of post-primary school organisation makes development of innovation of this nature difficult. However, unless alternative more flexible school patterns of school organisation can be developed it is unlikely that radical, beneficial changes such as typified by SCIART will be able to improve the learning situation and development of skills in post-primary schooling.

References

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