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The use of digital video in physical education

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This paper details the technical and operational aspects of a project investigating the role of digital video in physical education in 12 Irish schools over a period of two academic years. The project design involved a qualitative investigation into the use of digital video in three areas of physical education, namely teaching, learning and assessment. The group of physical education teachers who implemented the project received intensive training in the use of the technology initially and were also given additional training to meet the evolving needs of the project over its duration. The time demands placed on the team in terms of planning and preparation and post-production work were recorded. The motivational effect of the use of the technology on students was noted. The capacity of the technology to provide focused feedback on performances was examined through the reviewing of video clips of students’ performances in physical education lessons. The use of digital video as an aid to both formative and summative assessment in physical education was also examined. Aspects of assessment for learning were used in providing a cohort of students with opportunities to set their own learning goals and evaluate their own learning while compiling electronic learning portfolios. A total of 31 such portfolios were collated. An examination of the use of digital video technology as a means of assessing practical performances was also undertaken.

**Keywords:** digital video; physical education; technology; student portfolio

**Project background**

The project, which ran for two academic years in 12 Irish schools, was funded by the National Centre for Technology in Education (NCTE) and the Department of Education and Science (DES) in Ireland and was initially conceived in response to perceived challenges that appeared likely to arise in the context of assessment of new syllabuses in physical education in Ireland. In particular the Leaving Certificate Physical Education Syllabus (the approximate equivalent of A level in the UK), which would attempt to provide formal certification of student learning in physical education at Leaving Certificate level in Ireland for the first time, posed specific challenges as assessing, moderating and ascribing a standard to particular levels of practical performance for this terminal examination had not previously been attempted. The emphasis of the original project proposal was on the potential use of digital video as an assessment aid in physical education. This has been identified by many authors as a potential use of information and communications technology (ICT) (Apple Classrooms of Tomorrow, 1995; Baugh, 2002; Buckingham & McFarlane, 2001; Burden & Kuechel, 2004; Hall & Leigh, 2001).

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The potential use of ICT as a teaching, learning and assessment aid in physical education had not been previously investigated in Ireland. Specific reference has also been made by some investigators to the dearth of research information regarding the use of digital video in physical education (Cox et al., 2004; Reid, Parker, & Burn, 2002) although Green (2002) has pointed to some of the benefits of using digital video in physical education, notably to the positive impact on the learning process of playing a brief moving picture backwards and forwards, highlighting correct technique, and to the benefits, in terms of student observation and analysis, of using software that allows for two images on a split screen. Work has been carried out into the use of analogue video as a teaching aid in a variety of subject areas, but the use of digital video, and its capacity to interface with significant computer-assisted learning, was viewed as having the potential to provide an enhanced, integrated learning experience for students. Thomas and Stratton (2006) have noted that, although 40% of physical education departments whom they surveyed reported that technology was consistently used to analyse performances (and that this figure rose to 63% in specialist colleges), the majority of use of ICT in physical education was for recording and assessment purposes (54%). This suggests ICT technology is not being fully exploited to impact on pedagogical practices of teachers and to positively affect students’ learning.

The training needs of the Project Implementation (PI) Team were considered in light of the findings of other researchers. A variety of studies have indicated that technology will have little effect unless teachers are adequately and appropriately trained (Coley, Cradler, & Engel, 1997; Silverstein, Frechtling, & Miyaoka, 2000). Hall and Leigh (2001) additionally state that, in order for training to be most effective, it must be subject focused and not be on generic skills training. Although the UK Office for Standards in Education (2004) reported that over a third of the physical education departments visited were better placed to sustain and develop ICT use in subject teaching as a result of New Opportunities Fund training, Thomas and Stratton (2006) have noted that physical education teachers have been critical of training provided in the use of ICT in physical education as lacking direct relevance to the active classrooms that physical education teachers live in for most of their day. These factors were borne in mind when training needs for the teachers involved in the current project were addressed.

In general terms, the potential to upskill and engage a significant cohort of students while participating in an educationally interesting and enjoyable learning experience through the use of ICT was an important aim of the project. The capacity of ICT to ‘prepare pupils to participate in a rapidly changing world in which work and other activities are increasingly transformed by access to varied and developing technology’ (National Curriculum Handbook for Secondary Teachers in England, cited in Hall & Leigh, 2001, p. 2) was an important motivating factor in the project design. The compilation of electronic learning portfolios was also regarded as an important aspect of the work of the project in attempting to provide a means through which practical learning in physical education could be evaluated and a means through which aspects of assessment for learning could be incorporated into teaching and learning.

The final project proposal, which was accepted by the NCTE and the DES, focused on the use of digital video as a teaching, learning and assessment aid in physical education in Ireland.
Aims of the project

The aims of the project were as follows:

1. to train a cohort of teachers in the use of digital video and its associated software;
2. to assess how digital video could be used in a practical context in physical education and to establish the parameters of its optimum use;
3. to examine whether digital video could be used as an aid to assessment in physical education and, if so, to examine its validity as an assessment tool compared to traditional methods;
4. to produce a collection of resource and reference materials that could be used by teachers teaching the new Leaving Certificate Syllabus in physical education.

Project methodology

Post-primary schools within county Cork were invited to apply for inclusion in the project. A selection process took place and a group of 12 teachers, who formed the PI Team, were selected to implement the project in their schools under the supervision of a project coordinator. A detailed experimental design was given to all members of the team at the start of the project and monthly meetings took place between the PI Team and the project coordinator, where technical and operational issues were addressed and planning took place. An action research approach was adopted which relied heavily on the qualitative judgements of participants in the project to determine its effect on the teaching, learning and assessment processes. This approach was felt to be the most appropriate for a project of this size for a number of reasons. Firstly the type of information that was sought required a thorough analysis of its effect and was concerned with the underlying reasons for the success or otherwise of the use of digital video in education, rather than merely a quantitative assessment of this effect. Selwyn (1997) suggests that case studies that analyse what is happening in a technology-using classroom and that investigate the relationships the users develop towards the technology are of more value than studies that predict outcomes of technology use. His suggestion is that research should concentrate on the socio-cultural aspects of computer-based learning, a view also held by Kearney and Schuck (2003). The motivation, thoughts and reactions of the participants, together with an opportunity to explore concepts in sufficient detail, has also been indicated as one of the many strengths of qualitative research (Magenta Book, 2004). Thus the project looked at the process of teaching and learning, the intended and unintended consequences of observed interaction patterns, and the relationships among such educational actors (Le Compte, Preissle, & Tesch, 1993). The project focused on the process of using digital video and the views, perspectives, opinions, prejudices and beliefs of the participants were regarded as central to the investigation and were valued as such (Delamont, 2004). Thus the PI Team were encouraged to constantly feed back information which would influence the direction of the project to the coordinator and thus to the project steering committee.

The project had three phases to its investigation. Phase 1 looked at how digital video could be incorporated into teaching and learning with particular emphasis on its potential in providing enhanced feedback to students. Phase 2 looked at its role in assessment, particularly how technology could be incorporated into assessment for learning methodologies through the compilation of electronic learning portfolios. Phase 3 looked at how it could be used to create resource materials that could subsequently be used as teaching aids.
In the initial phase of the project, teachers were allowed to select one class as a control group and another, broadly similar, group as a comparison group to establish the parameters of using digital video in physical education. This represented an ‘estimate of the counterfactual’ (Magenta Book, 2005), accepting that there may have been differences between the two groups in terms of age, prior experience with using video, attitude to school and physical education, and so on. The intention in this phase of the project was to examine, inter alia, the practicalities of using digital video in physical education classes and to elicit the views of those involved on the benefits and shortcomings associated with its use. Pre- and post-participation information was sought from students in the form of a questionnaire and these data were used as part of a ‘between method’ triangulation process as suggested by Delamont (2004) and Burn and Leach (2004).

**Standardised interviews**

The coordinator conducted standardised interviews with the PI Team and school principals during Phase 1 of the project. As well as providing an opportunity for the collection of useful data and information, this also assisted the coordinator in fostering a problem-solving relationship with both the teachers and principals. This has been identified as a useful strategy by Delamont (2004). School principals were interviewed in a non-structured manner and invited to comment on any aspect of the operation of the project in the school. The members of the PI Team were also required to write a report under specific headings at the end of Phase 1 and Phase 3 of the project.

**Data collection and analysis**

A total of 453 students (203 males, 250 females) were involved in physical education lessons in which digital video was used as part of the Physical Education Video Project. The views of students and teachers regarding the use of digital video in the learning process were elicited via questionnaires and were regarded as an essential element of the research. Pre- and post-participation questionnaires were completed by a random sample of students in all schools. As observation, listening, remembering and detailed note-taking have been identified as key techniques for social researchers using participant observation and ethnographic methods of inquiry (Delamont, 2004), the members of the PI Team were encouraged to take notes immediately after any lesson in which they had used digital video and were required to keep a reflective journal in which they would keep detailed, analytical comments. Standardised interviews also took place with the PI Team and school principals, and the PI Team had to complete two formal reports during the project operation. Interview and questionnaire data were analysed using the MS Excel spreadsheet. Responses were indexed and coded into particular categories and patterns of similar responses were collated and analysed as a percentage of all responses.

**Results**

1. **Training of teachers**

The project sought to provide specific training on the use of digital video and its associated software in physical education. The PI Team received four days formal
in-service training in total during Phase 1 of the project and two more days training during Phases 2 and 3. In addition to in-service training, monthly meetings between the coordinator and the PI Team were used to identify any technical or operational problems that arose and to deal with these difficulties at the earliest possible opportunity. These meetings were also used for technical training on specific issues that had emerged. Among the technical areas in which the PI Team received training were the following:

- the use of the *Apple Mac Operating System*, *iPhoto* and *Apple Works*;
- the use and operation of the *Canon MV500i* digital video camera;
- laptop interface with camera;
- using *Apple iMovie* to edit video clips;
- setting up video recording in a school gymnasium – the use of TV, data projector and screen;
- practical use of digital video in a physical education lesson;
- highlighting individual performers using *Apple iMovie*;
- multi-session burning to CD-ROM;
- technical aspects of setting up a video recording suitable for dissemination;
- compilation of electronic learning portfolios using Keynote presentation software;
- exporting video from *iMovie* to *Keynote* and *Quick Time*.

The triangulation of evidence from a number of sources, that is, teacher and student questionnaires, standardised interviews with teachers, interviews with school principals, meetings between the coordinator and teachers (PI Team), formal reports from the PI Team, feedback from the Project Evaluation Team and quality of work produced by both teachers and students, indicated that the aims of the project regarding the training of teachers had been achieved.

The motivation for becoming involved in the project varied among the members of the PI Team but the desire for continuing professional development, and a genuine interest in ICT, were the most common reasons cited (Table 1). All teachers reported that they felt comfortable in the use of the technology by the end of the project, despite a steep learning curve for some, and that they had a clear understanding of the work of the project throughout. This is supported by the work which was produced by both teachers and students during the project, much of which was of a very high standard both technically and educationally. Some concerns were expressed by teachers as to the expectations of their level of technical competency at the project’s inception and the steepness of the learning curve involved for them. Of the 11 teachers who completed the project, nine of these considered themselves to have either a poor or a fair level of skill in the use of digital video at the start of the project. By the end of the project, eight of the teachers considered themselves to have either very good or excellent skills in this area (Table 2). All of the teachers increased their skill levels by at least two levels, for example poor to good or fair to very good, while three of them increased by three levels, for example poor to very good or fair to excellent. (Some changes in personnel in the PI Team meant that it was not possible to identify changes in perceived ability levels for all teachers.) As it was not possible to provide detailed in-service training to all members of the PI Team on all day-to-day technological aspects of the project, software tutorials, customised to the needs of the project, were developed and sent by email to the PI
Students were also trained by their teachers in the use of the technology during their physical education lessons. In all, 31 student portfolios were produced. Though the compilation of these portfolios was quite complex, requiring students to gain proficiency in filming using the digital video camera as well as being able to use iMovie and Keynote software, students took to this challenge with considerable enthusiasm. Students were asked, via questionnaire, where they felt most learning had taken place during the compilation of electronic portfolios and in what areas the use of digital video had been most beneficial overall. Table 3 shows that it was in the technical areas that students felt that most learning had taken place during portfolio compilation. The facility to receive precise, accurate feedback was the area in which students regarded the technology as being of most benefit overall (Table 4).

2. Establishing the parameters of the optimum use of digital video in physical education lessons

It was unclear at the start of the project what changes, if any, would be required to traditional teaching methodologies in order to maximise the potential benefit of digital video. The project experimental design used in Phase 1 asked teachers to concentrate on the practicalities associated with video recording certain activities and the use of the recorded material in providing feedback to students. Teachers were asked to teach the same material to two class groups – a control group who would not have the benefit of the digital video technology and an experimental group with whom the

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number of times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuing professional development</td>
<td>5</td>
</tr>
<tr>
<td>Interest in ICT in physical education</td>
<td>5</td>
</tr>
<tr>
<td>Equipment provided to school</td>
<td>2</td>
</tr>
<tr>
<td>Students’ learning</td>
<td>2</td>
</tr>
<tr>
<td>Persuaded by colleague</td>
<td>2</td>
</tr>
<tr>
<td>New ideas for learning</td>
<td>1</td>
</tr>
<tr>
<td>Benefits to school</td>
<td>1</td>
</tr>
<tr>
<td>Development of video resources</td>
<td>1</td>
</tr>
<tr>
<td>Practical nature of project</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1. Teacher motivation for involvement in the project (n = 12).

<table>
<thead>
<tr>
<th>Ability level</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Fair</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Very good</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2. Teacher-stated ability level using digital video before and after participation in the Digital Video Project (n = 10).
digital video technology would be used. Syllabus materials from the Junior Cycle Physical Education Syllabus (for students aged approximately 12 to 15 years) were provided to teachers to facilitate the process. When using the digital video technology with the experimental group, teachers were asked to focus on a specific aspect of the lesson and use the technology to aid teaching in this area. They were asked to note, while video recording, specific examples of when the focus of the lesson was captured on tape. They were then asked to bring the class together to highlight sections that were significant and use the video recording to reinforce the teaching point. In the intervening week teachers were asked to edit the video clips into a short section of video (two–three minutes) of relevant material where the specific point of the last lesson was captured on tape. This would then be shown as an introduction to the next lesson. Teachers highlighted this as being of particular benefit as they felt that it helped students to recap on learning from the previous lesson and focus on the objectives of the current lesson. The ability to demonstrate and highlight aspects of quality performances through the reviewing of video clips was identified by teachers as a significant teaching and learning aid as it helped students to identify key learning points. This is supported by the views of students who stated that the ability to identify one’s strengths and weaknesses was the area in which they felt digital video had been of greatest assistance to their learning in the project overall (Table 4) and that this was the best aspect of the entire project (Figure 1).

During Phase 2 (the portfolio compilation phase) of the project the PI Team observed that activities with specific discrete skills, like athletics field events, gymnastics and dance, were more suited to electronic portfolio compilation than large team games like Gaelic football or soccer, where the student may not have the opportunity to demonstrate his/her learning for long periods as the ball may not come his/her way. The PI Team also felt that, due to the relatively advanced nature of learning and the level of understanding required, electronic portfolio compilation of this type

<table>
<thead>
<tr>
<th>Area of improvement</th>
<th>Main</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical skills</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Performance analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Performance improvement</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Areas of student learning during portfolio compilation as identified by students (n = 31).

<table>
<thead>
<tr>
<th>Area of improvement</th>
<th>Main</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying strengths/weaknesses</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Technical skills</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Identifying key points of skills</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Better quality feedback</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Understanding the possibilities of the technology</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Acquiring new skills</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Attention to detail</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cooperative learning</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4. Areas in which the use of digital video was most beneficial, as identified by students (n = 31).
was an activity best suited to senior students (typically aged 15–19 years). When using the camcorder to record video footage in class, however, some items were compromised. Teachers felt that it was more difficult to provide verbal feedback to students while filming at the same time. They also felt that it reduced the complete observation of all students as the ability to ‘scan’ the class was reduced. As a result, the less active participant, who would normally receive more attention and encouragement, sometimes became more isolated. Using the camera’s display screen rather than the eyepiece when filming helped to alleviate this problem and teachers reported that the benefits of using digital video were visible in every lesson, even if it meant that the activity time for students was sometimes reduced. Considerable demands were placed on teachers in terms of planning and preparation for lessons in which digital video was to be used and there was also significant ‘post-production’ time required after each lesson in order to exploit the video material to its fullest potential. This time requirement reduced as familiarity with the technology improved.

Table 5 shows that it was in the area of student learning that teachers felt that the use of the technology had been most beneficial. Table 6 compares students’ stated proficiency levels using digital video before and after the project and indicates a shift towards greater confidence in the ability to use the technology at the end of the project with 25 out of 31 students rating their competency level as good, very good or excellent at the end of the project compared to only 10 out of 31 at the start. Students who were involved in portfolio compilation felt that most learning during this process had taken place in improvements in their technical or ICT skills (Table 3). Teachers observed that much of the learning that took place in this area was peer to peer. The PI Team felt that compiling electronic portfolios had been of high educational value. It was felt that students attended to the various concepts and skills central to quality performance in physical education more closely while using the technology – even though it was time-consuming. Teachers commented that students had little difficulty using the technology and that, in the case of students who were compiling their second portfolio, the increased familiarity with the technology meant that there was more

![Figure 1. Students’ views on the best and worst aspects of the project (n = 31).](image-url)
emphasis on learning and learning outcomes. The time required to compile an electronic portfolio reduced to between 8 and 10 hours at the second attempt, compared to approximately 12 to 14 hours the first time the portfolios were compiled. Teachers also felt that students focused on learning rather than performance as the product of a block of learning in which they were involved. This is interesting in view of the beneficial effects of focusing on the ‘task’ climate rather than the ‘ego’ climate, identified by Lee, Whitehead, Ntoumanis, and Hatzigeorgiadis (2001) as being essential to maintaining students’ long-term interest in physical education.

3. Formative assessment

Aspects of assessment for learning were used during Phase 2 of the project in an attempt to assess the potential of the technology as an aid to formative assessment in physical education. Students were invited to set their own learning goals and evaluate their learning over a unit of work. In all 31 student portfolios were produced and the quality of work produced indicates that compiling electronic learning portfolios in this manner is educationally valid, provides a significant record of student learning and may be very useful as a means of assessing student learning in physical education. It was felt that it would be too difficult a task for both teachers and students to allow them a completely free hand in the compilation of portfolios so members of the PI Team were provided with a template which gave some guidance as to the desired product.

In keeping with the action research nature of the project, a decision was taken at the end of Phase 2 to extend work on portfolio compilation to another unit of work. This afforded students who had worked on the first set of portfolios an opportunity to train their peers in portfolio compilation, something that proved to be very beneficial in the view of the PI Team. It also afforded an opportunity to verify that the time demands associated with portfolio compilation decreased when the second set of these were being compiled. Despite this, members of the PI Team expressed some frustration at difficulties encountered at school level in completing this process. The difficulty in gaining access to students outside of physical education class time and the fact that there was only one iBook computer available to all students posed difficulties for teachers. In this regard the PI Team made the point that a data projector is an

<table>
<thead>
<tr>
<th>Area in which digital video is most effective</th>
<th>Teaching</th>
<th>Learning</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teachers</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ability level</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Fair</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Good</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Very good</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Excellent</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 5. Teachers’ perceptions of where digital video is most effective (n = 12).

Table 6. Students’ stated ability level using digital video before and after participation in the Digital Video Project (n = 31).
essential aid when trying to teach a number of students how to use the technology using just one *iBook*. Teachers observed that it was the editing and compiling of the portfolio clips rather than the filming which was the most time-consuming. When students had to wait their turn to access a single *iBook* this led to obvious time delays and some frustration on the part of both students and teachers. Although 38% of teachers found that there were no difficulties associated with training students in portfolio compilation, time and student familiarisation were issues for 40% of teachers. Teachers felt that students who had compiled a second electronic learning portfolio were much more efficient in its compilation at the second attempt. This, it was felt, was largely due to efficiencies in the editing and compilation carried out by the students, as the time required to carry out the video recording was similar on both occasions. Overall time issues were the single worst aspect of the project as identified by six members of the PI Team (Figure 2) and 16 out of 31 students (Figure 1).

4. Resource compilation

The final phase of the project involved teachers and students in the compilation of resource materials in a variety of areas. Once again a template was provided so that teachers had some guidance as to what was required but they were allowed to choose the specific topic in which they were to create the video resource. As part of the final

![Figure 2. Best and worst aspects of the project in the view of the PI Team (n = 12).](https://example.com/figure2.png)
product of the project a DVD was produced containing all of the project materials. This DVD was distributed to all post-primary schools in Ireland. The DVD contained video resource materials, an electronic learning portfolio, sample lesson plans incorporating the use of digital video, a video tutorial on how to use digital video in physical education lessons, sample assessment sheets, student consent form, acceptable usage policy document, safety guidelines for video recording as well as the coordinator’s report.

Discussion
The work of the project suggests that using digital video can be of significant benefit in physical education, yet it is not simply something that can be applied to conventional teaching strategies without careful planning and preparation on the part of the teacher. The work of the project showed that, when teachers are given a chance to become involved in interesting and challenging initiatives, they avail of such opportunities with enthusiasm and commitment. The main reasons cited by teachers for becoming involved in the project were a desire for continuing professional development (CPD) and an interest in the use of ICT as an aid to teaching. These two factors may be the result of the dearth of CPD opportunities hitherto available to physical education teachers and an increased awareness of the potential of ICT in teaching and learning.

The PI Team remained motivated and focused throughout the project duration, despite the fact that the work was often time-consuming and demanding. Similarly high time demands have been reported by Gross (1998) in a project investigating the analysis of human movement using digital video. To help alleviate some of the demands which the Physical Education Video Project placed on both teachers and schools, two hours of paid substitution cover in the first year of the project and three hours in the second year were provided to the schools to allow teachers to carry out project work and attend meetings and so on. The training that teachers received had the effect of upskilling them in the area of technology while at the same time maintaining a high level of motivation among the group. In this regard, the software tutorials which they received were regularly commented on as being of particular benefit. These templates and tutorials helped teachers integrate technology into their teaching, a factor that has been identified as critical in the successful implementation of technology in schools (Silverstein et al., 2000; Sivin-Kachala & Bialo, 2000). The high level of satisfaction expressed by the PI Team with the training they received (Table 7), together with the quality of work produced, indicate that project objectives in this area were achieved. The perceived improved ability of the PI Team to use technology by the end of the project is borne out by the quality of work produced in the latter stages of the project and such increases in teachers’ technological skill levels and motivation have the potential to benefit significant numbers of students well into the future. According to Coley (1997), this type of benefit has been long neglected in terms of assessing the impact of technological initiatives in the classroom. Coley contends that:

more attention should be paid to the effects technology has on teachers and the way they teach. After all, students move on; they are affected by conditions that are both cumulative and changing, but teachers remain to influence another generation of students.

This increased ability to use technology on the part of teachers is mirrored by the perceptions of students who participated in the project who reported a marked increase
in their ability to use digital video at the end of the project. Though such perceived gains in ability were not empirically tested, the perception that they had improved in the use of the technology is, in itself, important, as it is indicative of a positive attitude on the part of students. Such attitudinal and motivational benefits have been reported by other investigators (Penuel, Golan, Means, & Korbak, 2000; Roblyer, Castine, & King, 1988; Schuck & Kearney, 2005, Silverstein et al., 2000; Sivin-Kachala & Bialo, 2000). This is further supported by Figure 1 which shows that the improvement in their technical skills together with the facility to receive enhanced feedback were the areas that students found most beneficial in the project.

The teaching methodologies most suited to the use of digital video indicated that its optimum role may be in the area of providing precise, non-judgemental feedback to students (Coley et al., 1997). In establishing the parameters of the use of digital video during Phase 1 of the project, the experimental design asked teachers to focus on the specific lesson objectives and make a note of opportunities to highlight these using recorded material. These were used during the lesson to provide feedback and thus reinforce learning. The teacher would then collate a number of these examples using iMovie and show them to the class at the start of the next lesson, both to recap on previous learning and to introduce the next lesson. This methodology was highlighted by teachers as being particularly successful. Teachers reported that it had the effect of increasing student motivation, reinforcing the learning objectives of lessons and creating a natural link between lessons. The importance of the use of technology in this regard is consistent with the observations of Coley et al. (1997), who state that the facility to individualise instruction and give instant feedback to students is one of the key benefits of computer-based instruction. Other investigators such as Kibble (2005) and Tearle, Golder, Moore, and Ogden (2005) have also noted the ability to receive more precise feedback as one of the main benefits of using digital video as a teaching and learning tool in physical education.

Regarding the use of digital video as an aid to formative assessment, the indications are that the compilation of electronic learning portfolios may well provide an interesting, enjoyable and educationally valid means through which students can demonstrate progression and learning over a prolonged period. These e-portfolios, described by Barrett (2006a, p. 1) as a ‘collection of work that a learner has collected, selected, organized, reflected upon, and presented to show understanding and growth over time’, demonstrated that the use of digital video technology has the potential to make a significant contribution to this area in physical education, where much of the learning is practical and can only be demonstrated by practical performance. The setting of learning goals and the reflection on learning on the part of students, which was required in the portfolio template provided, was in keeping with assessment for learning. The template served as a guide to students in their work on electronic

<table>
<thead>
<tr>
<th>Quality of training received</th>
<th>Number of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>0</td>
</tr>
<tr>
<td>Fair</td>
<td>1</td>
</tr>
<tr>
<td>Good</td>
<td>3</td>
</tr>
<tr>
<td>Very good</td>
<td>5</td>
</tr>
<tr>
<td>Excellent</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7. Teacher assessment of the quality of in-service training provided (n = 10).
learning portfolios, although it was not intended to, and did not in practice, limit their creativity in their work. Thus issues of individuality, creativity, and ownership identified by Barrett (2006a) as among the limitations of their paper-based predecessors did not emerge in the compilation of electronic portfolios and the process attempted to ‘truly engage learners… through incorporating emerging technologies that motivate and engage’ (Barrett, 2006a, p. 3). The template asked students to record their performances at the start, mid-point and end of a block of learning. These performances were edited using iMovie and exported to Quick Time movies using the MPEG 4 codec. This codec was chosen as it offered the optimum trade-off between file size and quality. Though the quality of movies at full size was not sharp, this problem was overcome when the movie screen size was reduced to fit into a Keynote slide. The movies were inserted into Keynote and then embedded into a presentation where students commented, inter alia, on the goals which they set themselves for the block of learning, whether they felt they had achieved those goals and how it felt to compile the electronic learning portfolios. The challenge faced by members of the PI Team was that they had to become familiar with the educational philosophy underpinning the use of electronic learning portfolios and also become adept at using the relevant technology. Similar difficulties have also been noted by Barrett (2006b), who observed that ‘for many teachers… there was a dual learning curve: learning the TaskStream technology tools and learning to use portfolios with students’ (p. 14). The PI Team found this to be quite challenging initially and reported that the initial time required to train students in the compilation of portfolios was the main difficulty encountered.

Teachers found the resource compilation phase of the project (Phase 3) easier to work on than the area of portfolio compilation. In addition they felt that students also enjoyed being involved in the compilation of teaching resource materials as they liked having their expertise in particular disciplines utilised. Discrete skills were easier to work on than other aspects such as tactics involved in team games and teachers found that compiling the resources was not as time-consuming as they had expected. Though the template provided was again regarded as useful, some teachers said that a standard template with preset movie sizes, fonts, font sizes and colours would help the resource material to have a standard feel to it, while others said that the flexibility allowed meant that they could experiment with different designs and they felt that this was an advantage. All felt that planning what was to be filmed and where and how filming would take place was crucial to avoid wasting time and in this regard detailed storyboarding was very useful.

A video tutorial showing how to use digital video in a physical education lesson was scripted by a member of the PI Team and shot in one of the project schools. It is the first resource of its type produced in Ireland and is aimed at encouraging all teachers to use the technology as an essential part of their teaching and at the same time demonstrating how comparatively easy it is to use.

**Conclusion**

The use of digital video was found to be a worthwhile aid to the education process in the view of the participants in the project. It was regarded as a useful aid to learning and in maintaining student engagement. Structured interviews with the PI Team confirmed the view, however, that digital video is not something that can be introduced in a haphazard or unplanned manner. Rather it requires a fundamental reassessment of
the role of the teacher and the learner in the learning process in order to maximise its potential (Penuel, Golan, Means, & Korbak, 2000). As Mishra and Koehler (2006) point out, the optimum exploitation of technology requires skills and knowledge not just of technology, pedagogy, and content in isolation but rather of all three taken together, that is, technological, pedagogical content knowledge. Cox et al. (2003) also point out that if ICT is to have a positive effect on pupils’ attainment, then the technology should support the underlying instructional approaches and that the effective use of ICT should not mean the absence of organised structure. A learning environment where the teacher acts as facilitator in a carefully structured lesson (Ringstaff & Kelley, 2002) and where students feel that they are truly active in and fully engaged in the learning process at all levels is an environment best suited to the use of digital video. Such careful planning is also advocated by Wood (2005) who, mindful of a possible reduction in actual physical activity in lessons in which technology is used, suggests that ICT must be used to enhance physical activity, not distract from it, and that its effective use requires systematic planning and considerable initiative. The findings of Thomas and Stratton (2006) that teachers often see ICT as a distraction from what they regard as the more important, practical, active focus of the subject must be taken into account. Teachers who are sceptical as to the benefits of using ICT in physical education have to be listened to and respected, especially in view of the inconclusive findings of the Office for Standards in Education (Ofsted) (2004) as to the impact of the use of ICT on student attainment and the quality of teaching in physical education. With regard to the use of digital video in particular, however, Ofsted’s findings that the development of high-quality digital video and feedback facilities in a significant minority of schools is having a significant impact on pupils’ progress are noteworthy, as are the findings of Stidder and Hayes (2006) that 95% of physical education trainees indicated that they were able to use video within their placement schools. Even if the philosophical objections of sceptics can be overcome however, issues such as the availability of financial resources to purchase the necessary equipment, pupil–teacher ratio in classes as well as the general quality of facilities available will determine each school’s response to the key practical questions raised by Hall and Leigh (2001) as to whether the technology can be used by all students, some students or by a teacher using a large display as part of whole-class teaching.

The introduction of digital video into teaching and learning, therefore, should be gradual, purposeful and subject to regular review on the part of both teacher and learner, bearing in mind that new technologies at most enable rather than dictate change (John & Baggott La Velle, 2004). As Hofer and Owings-Swan (2005) state:

Analogous to the writing process, teaching technology is much like teaching students how to compose a critical essay for the first time. It needs to be done in stages, broken down with appropriate scaffolding. Additionally, the outcomes need to be modest in the beginning phases with the understanding that technology might eclipse, in this case, some of the historical thinking benchmarks. However, with more exposure, the technology and content goals may be slowly inverted so that the technology will likely fade to the background as proficiency increases. (Hofer & Owings-Swan, 2005, p. 108)

It is also important that the technology is always seen for what it is – a means to a worthwhile educational end – and that the novelty of using the equipment does not become the dominant feature. Clear relevance to the needs of teachers and students has to be established and teachers have to be convinced that using digital video, as with the use of ICT in general, will allow the teacher or the student to achieve
something that could not be achieved as effectively or efficiently without its use. Hall and Leigh (2001) have pointed out that questions relating to the use of technology in physical education relate to whether there are specialist tools that will help a teacher to achieve the learning aims, rather than asking ‘Which tool shall I use today?’.

Thomas and Stratton (2003) have cautioned that while seeking to edutain, we must be careful that a technotainment bandwagon, where too much fun takes precedence over educational value, does not take over.

The potential of the use of technology to enable students to develop their own meaningful representations of knowledge using ICT has been pointed out by Cox et al. (2003) and is supported by Wood (2005), who points to the truly transformational effect which the use of ICT can have on learning. These powerful educational advantages, where students are able to construct and develop their own meanings and uses for ICT in general, and digital video in particular, are such that their use should become increasingly valued in a twenty-first century society that places such emphasis on communication, teamwork and problem-solving (Penuel, 2000).

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References


