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Slowmation: Exploring a New Teaching Approach in Primary School Classrooms

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Abstract. Digital animation is a complex process that has been used in commercial movies such as Happy Feet, Chicken Run, Shrek and in educational resources that are made by experts. A new teaching approach called "Slow Motion Animation" (abbreviated to "Slowmation") has been developed at the University of Wollongong and simplifies the complex process of animation so that learners can make their own animations of science concepts. This paper explores the extent to which this new teaching approach was used by 10 primary teachers in their school classrooms. The teachers were introduced to the approach at a one-day inservice course in July 2005 and were involved in a follow up study over 12 months to investigate if they had used it in their teaching. Data collected indicated that 8 of the teachers used the approach in various subjects and to different extents. Two of the teachers became regular users with children in year 1 and year 4 making several animations. A focus group held at the end of 12 months identified two issues that inhibit teachers using the approach: (i) there are issues about classroom management when using slowmation with a whole class; and (ii) access to appropriate technologies.

Introduction

Wikipedia defines the process of animation as "the optical illusion of motion created by the consecutive display of images of static elements. . . .when the frames are strung together and the resulting film is viewed, there is an illusion of continuous movement due to the phenomenon known as persistence of vision." There are three main forms of animation with various sub types that are categorised according to how the images are created, the materials involved and technology used (Taylor, 1997). The first form is called traditional or hand-drawn animation. This includes the many cartoons and feature length films that were made in the past 70 years which is sometimes called "cel animation". In this form, diagrams are drawn or traced on to transparent acetate sheets so that they can be shown quickly to simulate movement. A second form, stop-motion animation, involves taking digital still photographs of objects or pictures as they moved manually to simulate movement. This form includes clay animation which was first introduced in the early 1900s and was made famous by "Gumby" and Will Vinton's use of the term "claymation" in 1978 (Wells, 1998). A third form, the most recent and popular, computer-based animation, involve moving images that are created digitally on a computer using a wide variety of new techniques. Table 1.1 summarises these three forms of animation.

Table 1. Different Forms of Animation

Form of animation	Feature	Types	Examples
1. Hand-drawn animation (cel animation)	Images are hand drawn and copied or scanned onto a computer	Cartoon animation Character animation Limited animation Rotoscoping	Flintstones Jetsons The Lion King Disney Cartoons
2. Stop-motion animation	Objects, models or images are created and small movements are made by hand and individually photographed	Clay animation Cut out animation Model animation Object animation Puppet animation Silhouette animation	Wallace and Gromit Gumby Chicken Run The Muppets Harvey Crumpet Monty Python (dada)

			animation)
3. Computer-generated animation	Images are created digitally and manipulated on a computer	2-D and 3-D animation Skeletal animation Motion capture animation Morph target animation Flash animation Power point animation	Shrek Cars Happy Feet Finding Nemo

But no matter which of the three types of animation is considered, their use as a teaching approach in primary schools is extremely rare. A review of literature using ten different international databases that cover publications over the last 20 years using the four terms *claymation*, *clay animation*, *stop motion animation* and *stop frame animation* produced a paucity of research publications — ERIC (Educational Resources Information Center) produced three articles; The Association for the Advancement of Computers in Education (AACE) Digital Library produced one article; Proquest produced 191 articles; Expanded Academic ASAP Plus produced 26 articles; Informit 0; Australian Education Online 0; ISI Web of Knowledge 2; Science Direct 0; and ACM Digital Library 200 articles. Moreover, of the 423 articles about claymation, only three focus on its educational value, as 421 describe the procedures for making claymation, the use of new technologies or are advertisements in magazines. Of the three articles which promote the educational value of students performing claymation, one argued for the value of claymation to encourage visual literacy of preservice teachers (Witherspoon, Foster, Boddy, & Reynolds, 2004), one supported the use of clay animation to promote school students' literacy skills (Gladhart, 2002), and one promoted the use of clay animation to encourage school students' collaboration (Gamble, McLaughlin, Helmick, & Berkopes, 1995).

In Australia, several school-based action research studies using claymation have occurred in conjunction with South Australia's Technology School of the Future. One project, *Clay Animation in the Primary Classroom*, was conducted at Hawthorndene Primary School and investigated the use of clay animation as a teaching and learning tool to enhance outcomes for disengaged and underachieving students (Murtagh, 2004). Titles of the QuickTime movies produced include a "Zoo Trip," "Snakes", "Hamburger" and "Elephant Sandwich." The study concluded that "clay animation as a teaching and learning tool is an exciting, time-consuming, challenging, motivational process and above all, a lot of fun. It can impact in a positive way on learning, group skills and teamwork, self-esteem, confidence and leadership skills." Another action research project, *Student centred curriculum – multi-literacies and disengaged learners*, was conducted at Tintinara Area School using claymation to assist year 4-6 boys to improve their literacy skills (Murray, Neville, & Webb, 2005). The boys wrote stories with a selected theme, put them on a storyboard, constructed clay figures and backdrop scenes, used digital photography and then completed written evaluations. The study found that the targeted group of boys needed more explicit teaching of narrative structure to enhance their stories and they became aware of the importance of planning and structuring their narratives. However, in both school-based projects, clay animation did not become a common teaching approach as there were difficulties in storing the clay models over extended periods of time, there was a need for adult assistance and the production process was very time consuming needing up to two school terms to complete (students worked on them at different times).

The use of computer-based animations to enhance student learning, however, is much more prolific in the literature as a consequence of large sums of money spent on experts designing animations to be placed on web sites or CDs as learning objects. Designed on a cognitive theory of multimedia learning, which explains that people learn better from pictures and words than words alone, many different types of computer animations have been created (Mayer, 2005). Importantly, Mayer explains that are two

approaches to multimedia learning: (i) technology-centred approaches which are underpinned by the functional capacities of new technologies and so accentuate the affordances of the technology; and (ii) learner-centred approaches which are underpinned by an understanding of student learning and how multimedia design can be adapted to enhance student learning. What is significant in regard to this chapter, is that both technology-centred approaches and learner-centred approaches to designing multimedia involve experts designing animations *for* learners to use and do not involve the creation of animations *by* learners. For example, the well funded National Science Foundation projects in the USA such as the Technology-Enhanced Learning in Science Center and the Concord Consortium have produced hundreds of computer animations to promote science education (Viadero, 2007). And in Australia, The Learning Foundation, which is an \$80 million initiative of the state, territory and federal governments of Australia and New Zealand, have produced large numbers of animations that are freely available on a web site or CD for use in teaching science. But nearly all of these examples of computer-generated are made by experts and there is little evidence of animation being used as a teaching approach in schools especially in a way that supports learners being the designers and creators of animations.

The Development of Slow Motion Animation (Slowmation)

Slow Motion Animation (abbreviated to “Slowmation”) is a new teaching approach that has been developed over the last two years in science education classes at the University of Wollongong. This approach simplifies the complex process of making animations to enable learners to create their own comprehensive animations about science concepts (Hoban, 2005, in press; Hoban & Ferry, 2006). Slowmation is similar to clay animation involving students researching information, storyboarding, designing models, capturing digital still images of small manual movements of the models, and using computer programs such as QuickTime Pro™ to play the images in a sequence to simulate movement. In addition, a key part is that the students write scripts as the basis for a narration to explain the science concept. “Slowmation”, however, is different from claymation in five key ways as shown in Table 2.

Table 2. Comparative Features of Slowmation and Claymation

Feature	Claymation	Slowmation
<i>Content/purpose</i>	Tell a narrative	Explain a science concept
<i>Materials</i>	Clay or plasticine	A variety such as soft play dough, plasticine, 2-D pictures, drawings, existing 3D models, felt, cardboard cut outs and natural materials such as leaves, rocks or fruit
<i>Orientation</i>	Models are made to stand up vertically and moved incrementally as they are photographed with a digital still camera mounted on a tripod looking across at the models	Models are mostly made on the floor (flat) and moved horizontally as they are photographed with a digital camera mounted on a tripod looking down at the models (this is not always the case, however, as existing plastic models can be photographed in the usual way)
<i>Pedagogical Prompts</i>	The art of telling the story explains the experience	Prompts are included to explain the scientific concept such as audio narration, music, humour, diagrams, models, labels, questions, static images, repetitions and characters
<i>Timing</i>	12-24 frames/second to simulate real movement	2 frames/second to slow down movement

Most importantly, slowmations are played in slow motion at 2 frames/second, not 24 frames/second as in clay or computer animation because the purpose of slowmation is to show and explain a scientific

concept slowly, not to represent a narrative or story in real time, hence the name “Slow Motion Animation” or “Slowmation”.

Over the last two years, slowmations averaging 3-4 minutes in length, which are like mini movies of science concepts, have been created by preservice primary teachers about many science concepts including day and night, seasons, tides, life cycles of various animals, particle motion, magnets, mushroom life cycle, plant reproduction, weather, movement of the planets, water cycle, simple machines. In a secondary science context, slowmations have been made of mitosis, meiosis and phagocytosis. Because slowmations are easier to make than traditional animations and are played 10 times slower, preservice teachers can represent *their own understandings* of science concepts in very comprehensive ways (Hoban & Ferry, 2006). For example, one slowmation explaining the causes of day and night goes for 5 minutes, includes 600 digital photos, targets movement of the earth in relation to the sun and phases of the moon, commences with moving 2-D images of day and night using cut out felt that is moved manually and then progresses to moving 3-D polystyrene models. Importantly, the animation is accompanied by the pedagogical prompts of music, questions, diagrams and captions explaining the science content. In all, it took a preservice teacher 25 hours to create at home in a room with a dimmer to simulate effects of changing light on the earth and moon.

Phases in Teaching with Slowmation

There are four main steps or phases when using slowmation as a teaching approach to a class of university students or school children.

Phase 1. Planning

The instructor and/or preservice teachers *plan* a topic or concept to animate which involves change. It could mean explaining to the students that they are making a “mini animated movie” of a science concept. This initially means that students conduct *research* on a particular topic in order to have enough information to identify a sequence with several stages, sections or episodes. Alternatively, the instructor may explicitly teach topic or concept to give students a “big picture” representation of the relevant concept. In a primary/elementary science context, this could include topics involving change such as the four seasons, seed germination, life cycle of a frog, the water cycle, life cycle of a caterpillar, why boats float, a rocket blast off, chemical reactions, particle motion, phases of the moon, development of a volcano, plate tectonics, mountain building, weather patterns, geological movements, digestion or movements in the solar system. Importantly, pedagogical prompts to explain a concept need to be decided but these may evolve during construction. The teacher needs to decide if the animation will be made by the whole class or in small groups.

Phase 2. Chunking and Sequencing

There are two layers of analysis to break up the concept into its component parts. First the topic needs to be analysed into 3-5 “chunks” or episodes that make up the whole concept or topic. Second, each chunk has to be further broken down into sequences or small movements to be digitally photographed for making the animation. Each chunk needs to be storyboarded showing the sequence of the incremental movements to explain the science involved. This analysis can guide an individual for making the animation or can be the basis allocating chunks to groups of students for a class project similar to a “jigsaw” approach. For example, a chunk could include one of the life stages of a frog, one of the four seasons, one of the stages of a rocket take off, one stage of a volcano developing, one part of meiosis or mitosis or one part of a chemical equation.

Each group needs to carefully plan the required number of movements for their particular sequence of the concept or topic in a storyboard. Once the sequences are established, specific roles can be

negotiated within each group. In a school situation roles can be allocated such as content expert, model maker, script writer, photographer, background designer and runner (who is the only one who can ask the teacher questions). It is important at this stage to again reflect upon how the concept can be best explained — should the slowmation only be photographs and text or should it just have a narrated storyline and music or both? It is recommended not to use too much text in the photos because too much text takes away from watching the animation and listening to the narration. Hence, it is advisable to script a narration for the whole animation but only include text as written labels to highlight key features. Also, further research may be needed to explain each section or to clarify or seek extra science information.

Phase 3. Construction

The construction phase involves *making* and *photographing* of the models using a variety of materials such as modelling clay, real materials or pictures. Decisions also need to be made as to whether the slowmation is going to be constructed on a blank cardboard sheet or white butchers paper to be rendered as part of a background. Usually, the models are made laying down on a sheet of project cardboard on the floor. A digital still camera needs to be mounted on a tripod and positioned over a sheet of cardboard so that pictures can be taken vertically looking down at the cardboard. The students make each of the small movements in the model manually and a photograph is taken of each movement. The photographer needs to take at least 40-50 photographs of each chunk. It is simpler if the photographs are taken in order of the presentation of the sections for the whole story. Another way is for each group to have their own camera and produce their own QuickTime movie which is collated when editing. Backgrounds can also be added to enhance the photos. An important aspect of construction is to insert arrows and labels to highlight the key features. If existing plastic models are used, the models can be moved standing up with photos taken at a slight angle to the horizontal.

Phase 4. Reconstruction

Once all the digital still photographs are taken, they need to be *downloaded* onto a computer, copied onto the desktop and *imported* into a computer program to put the whole process back together again. An animation program such as QuickTime Pro or Stop Motion Pro is needed to import the photographs. The procedures for using the technology are more fully explained in Appendix 1. QuickTime Pro is commonly used because it is simple to use, the playback speed is easily selected and varied (usually 2 frames per second) to produce a QuickTime movie that can be played on any computer, PC or Mac. The command “open image sequence” from the FILE menu allows you to select which sequence of photographs you want to import. It is important to remember that more technology does not always mean the best slowmation — less sometimes means more when it comes to a quality slowmation. The important question to answer is how is the concept best explained and what technology will enhance this process? A slowmation may just have music to create a mood, use of a narrative that needs to be scripted to match the different images presented or have text added as well. Once the initial animation is made, refinements need to be added to *enhance* and *edit* the animation. These can be made in several ways such as importing into iMovie, adding music, factual text as static images, transitions, other backgrounds or a narration.

An important pedagogical consideration is that different QuickTime movies can be made showing the process at different speeds. As the students have worked on different sections of the process, they need to know what the other sections were about. The value of a slowmation is that multiple QuickTime movies can be made easily to show the movie at different speeds for different purposes. Initially teachers can show a slowmation at 2 frames/second to give the overall change process and make another movie to be shown at 5 or 10 seconds per frame so each group can explain the details of their section to the rest of the class.

Methodology

The purpose of this 12 month study was to ascertain to what extent the primary teachers used slowmation in their classes. Ten primary teachers from five different schools were invited in July 2005 to participate in a one day inservice course to learn how to design and make a slowmation. Only one of the teachers who attended was a confident user of technology. The full day inservice course taught the teachers how to use the animation program, QuickTime Pro and they were also provided with resources such as a tripod and crayola dough to take back to their classrooms. A research assistant was employed to follow up the teachers in the classroom to interview them about their use of the approach. Each of the teachers was visited once to be interviewed during the 12 months, examples of any slowmations created were collected and 5 of the teachers were also involved in a focus group discussion at the end of the 12 months to review their opinions on using slowmation.

Results

Interviews with the 10 teachers were analysed for indications of use, non use, challenges and benefits of attempting to implement the teaching approach in their primary classroom. These data are summarised in Table 3.

Table 3. Outcomes of Teacher Use of Slowmation

Teacher	Initial Use	Multiple Use	Key Learning Area (subject)	Challenges	Benefits
A. RFF	Yes	Yes, 10-15	Science and Maths (symbols and tables) PDHPE (Friend making) HSIE	Time management	Valuable for deep understanding "It made me think more about deconstructing the learning and making the children work through what they have learned."
B. (Year 1)	No	No		Time constraints "with year 1 things take longer"	
C (Year 4)	Yes	No	Maths Cross section of prisms)	Time constraints "finding time in an already busy schedule"	Easily fitted into regular lessons "In the actual modelling of the shapes they had to look much more closely at the feature of this shape so it was made more meaningful"
D (Year 2/3)	Yes	Yes, 7	Science (changes of state, seasons, density)	Time constraints and clear instructions "Time wise it takes up a reasonable amount of time" "Need to demonstrate each step so that children actually understand what to do"	Reflective "It makes you think more about your teaching more and makes you think explicitly"
E (Year 3)	Yes	Yes, 4	Social Science (camp activities) Science (life cycles)	Early finishers if equipment limited "Providing the finished groups with something to do"	Lesson Planning "It does make you more aware of the fact that you do need to look at the small components of the topic" Worked well with Peer support task with year 3 helping kindergarten
F Year 1)	Yes	No	Science (life cycle of frog)	Time consuming "too hard for stage 1 children"	Did not influence her lesson planning
G (Kindergarten)	Yes	No	Science (life cycle of silkworm using peer support)	Time and manipulation "Kindergarten had difficulties manipulating materials"	Worked well with peer support
H	Yes	Yes, 3	Maths (fractions)	Classroom management "I did some with small groups in the relief from face to face time"	"I could see endless possibilities in the classroom. it made me teach the kids methodically because they really had to be a lot more analytical"
I	No	No			
J Year 1	Yes	Yes, 4	English to represent stories	Classroom management	"the children got better and better, once they understood the process they were able to do it all themselves"

In summary, of the 10 teachers involved, 8 teachers tried it once in their teaching and 5 teachers used it several times during the year. Of the 5 who used it more than once, 2 teachers have continued to use the teaching approach multiple times and have assimilated the approach into their regular classroom practice. Of these two teachers, one was a year 1 teacher who made four slowmations with her class over the year. One important modification that she tried was that the year 1 children experienced too many difficulties when using crayola dough and so instead switched to using existing models. Hence in her third slowmation, the children used existing plastic toys of dinosaurs to animation when making a slowmation of the story, "The Triceratop Twins" and in their fourth slowmation, the children used plastic lego and dolls as they animated the story of "Jack and the Beanstalk."

Particular challenges that the teachers referred to that inhibited them from using the process was the crowded curriculum and not having enough time to implement it, having access to the technology when needed (digital camera, tripod and computer) and the issue of classroom management when there is only one computer. For example, a problem identified was what to do with the other children when the teacher was working with the group that was taking the digital still photos. Several teachers commented on the benefit that it made them think more about their teaching in terms of how they plan their lessons and they saw the value for the children's learning if they use the approach to represent a topic. Of particular interest from the interviews was that the slowmation teaching approach was used in five different key learning areas — Science, Mathematics, English, Physical Development, Health and Physical Education and Social Studies.

Discussion and Conclusion

Slowmation is a new teaching approach that has been developed over the last two years in university classes and until this study had not been explored by teachers in primary schools. This study invited 10 primary teachers who were mostly reluctant users of technology to participate in a one-day inservice course to explore if and how they used it in their primary classes. It is clear from the data analysed that most of the teachers used slowmation but to different extents. Of the 10 teachers, two became regular users and assimilated the approach into their regular teaching practice. Two of the teachers did not try it at all and three of the teachers only tried it once. A common problem that the teachers identified was that the process was time consuming, it involved some classroom management issues and the teachers need regular access to the technology. Although the amount of technology is relatively small (need one tripod, one camera and one computer with QuickTime Pro), teachers only need one of these items not to be available at the time and it will inhibit their use of the technology.

Of the five teachers who used the approach several times, the most frequent user was the relief from face to face teacher at one of the schools. His focus for his relief from face to face position was teaching technology so he found it very useful for the children to use the animation process. One interesting point is that the two teachers who have assimilated slowmation into their regular teaching have adapted the approach in varied ways. Teacher J decided that the use of crayola dough was too difficult for year 1 children so she decided to continue using the approach but not with soft dough material. Instead she decided to use existing plastic models and the last two slowmations that she made she used models of plastic dinosaurs and small lego dolls. Importantly, she noted that because her six year old children had made several of the slowmations, they had become familiar with the process and by the fourth time the children took control of the process which means that the six year old children took the photos as well as making all the manual movements of the models. The teacher had overcome the issues of classroom management by having the children allocated into pairs to use the technology whilst the other children continued with work set.

In conclusion, it is widely recognised that the primary curriculum in Australia is overcrowded and that teachers need time to try any new approach and some are reluctant to try any at all. Hence any new teaching approach that is introduced to teachers needs a good deal of time, reflection and trialling before it becomes part of their pedagogical repertoire. This study showed that a few of the teachers were able to assimilate it into their regular teaching practices. Another interesting insight is that the teaching approach was used in five different key learning areas which suggests that the approach possibly has widespread use. This study also showed that one of the major impediments of teachers that inhibits them trialling new teaching approaches is a lack of time. The primary curriculum in its existing form is impossible to complete with teachers having to implement the six main subjects. Also this study did not have the resources to provide ongoing support of the teachers when they returned to their classrooms which could have been another factor that limited their use of new technology. Further studies will need to occur to ascertain if the teaching approach is valuable for student learning and if the impediments to using the approach can be addressed.

Note

Slowmation won both categories of the 2006 Technology Leadership Awards presented by the international Society for Information Technology and Teacher Education (SITE) which is one of the three sub groups of the Association for the Advancement of Computers in Education (AACE). The author of this chapter won the category *Exemplary Use of Technology to Teach Content in a Teacher Education Methods Course* and his B.Ed. (Hons.) students won the other category *Exemplary Use of Technology to Teach Content in the Induction Years in School*. The author would also like to acknowledge the support of EmLab (Educational Media Laboratory) at the University of Wollongong, Australia for their assistance in developing slowmation.

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Appendix 1

Making a “Slowmation” (Slow Motion Animation) Using QuickTime Pro

by Garry Hoban, University of Wollongong, Australia (modified 20-4-07)

A. Purchase QuickTime Pro at the online Apple Store <http://store.apple.com/quicktime/mac.html> (a code will be sent via email to put into your existing QuickTime) by paying A\$44.95 (PC and Mac versions) or US\$29.99. QuickTime has a very good “Help” section and step by step tutorials are available at <http://www.apple.com/quicktime/pro/tutorials.html>

B. Taking the photographs

1. Make sure the students are aware that many small movements are best (make a simple animation on some post it notes and flip them)
2. Lay down a project sheet or butchers paper and build the models on the floor in the horizontal plane with the camera mounted on a tripod looking down at the models. Make sure the models/play dough are movable and not stuck to cardboard.
3. Make sure the camera is set on “**LOW RESOLUTION**” or the “**SMALLEST SIZE**” such as 640 x 480. If you are using more than one camera make sure that they are set on the same photo size.
4. Take the photos moving the materials one small bit at a time. A three minute slowmation needs over 300 photos.
5. Include labels of key concepts taking one photo which can be copied repeatedly for a static image later.

C. Making the animation

1. Click on QuickTime Pro
2. Select “File” and select “Open Image Sequence”. (For PCs select frame rate at 2 frames/second)
3. Locate Folder with digital images and click on first image
4. Click on “Open”
5. A new dialogue box appears, select the desired frame rate (usually 2 frames/second) and Click “OK” and the Quicktime movie will appear on the desktop.
6. Open the File menu and select “Save”. Write the title in the dialogue box and select where you want to save it, click “OK”. Make sure you “save as a self-contained movie” as this will make it independent with the photos compressed within the movie.

D. Making static images to suit a narration

1. Open the movie and play the movie until you get to the important photo that you need to stay longer on the screen. Use the stop button to stop the movie and go to Edit and select “Copy” and then “Paste” the photo about 10 times or as long as you want it to stop. Make sure you bring together the small edit tabs until they disappear otherwise you will keep unwanted images in the memory.
2. An alternative way is to open a photo in a graphic program and type in labels.

E. Adding a sound file— narration or music

1. Slowmations need a narration or text but not both. If making a narration open “File” and select “New Audio Recording”. Make sure that the microphone in the computer is turned on or use an external microphone. Click on the sound file and then the animation to record the narration. Delete the first second of the audio file (using the tabs) so that it matches the animation.
2. If adding a music file, Open “File” and select “Open File”. Locate the music needed and click on it. Make sure the length of the music matches the length of the animation
3. Click on the narration or music file, choose “Edit” and select “Select All” and then “Copy.”
4. Select animation and choose “Add to Movie”.
5. It is important that you click “save as” and save it as a “self-contained movie” to embed the sound track.

F. Saving the animation

1. When you click “save” there are two choices. You can save the animation as a “Self-contained movie” which means that the photos and sound file are embedded as a self-contained unit in the animation (and can be copied and shared) or as a “Reference movie” meaning that the animation is linked to the photos or sound on your computer but will not copy for sharing. Hence, you must “save as” a self-contained movie which is bigger than a reference movie.

G. Modifying the animation

1. Edit the QuickTime Movie itself with delete, copy and pasting in new photos directly.

H. Emailing an animation

1. Open animation and Choose “File: and select “Share”
2. Select size “small or medium”, click “share”
4. Movie is automatically attached to an email. Write email address in box and press send. (try around 500kb-1MB)

I. Downloading to an I-pod

1. Open animation and go to “File” and then “Export” Select “Export” and click on “movie to MPEG-4 and click “Save”
2. Copy QuickTime movie in MPEG-4 format into I-tunes
3. Syn to I-pod in movie section. Use forward and back arrows to repeat slowmation.