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Beyond the Fun: Three Dimensions of 3-D Animation

by Vivian Griese

So What Do You Think?

Thinking is a skill that is in great demand in our modern society. Employability studies document the need for a future work force capable of a more sophisticated way of thinking than generally required in the past. Skills such as independent analysis, flexible thinking and collaborative problem solving are now considered basic requirements for many jobs (Costa, 1991). The arts are a natural avenue for developing these skills, but many consider the arts as "insignificant" or "extras" in the curriculum. With today's advances in technology, the arts have been successful in adapting these new media in the classroom. One only needs to observe the explosion of 2D and 3D animation movies as well as the wide range of video and computer games that are readily available. Many artists have found a successful niche in this computer driven industry.

Hampton City Schools, where this author teaches, has made a commitment to integrating technology in all areas and improving the work force for area industries. The partnership between the schools and the business community is working towards developing a work force that meets the need for higher order thinking.

The arts have been an active partner in this area as well. All four of the city's high schools teach three levels of 3D Animation. Each high school has a computer lab with Macintosh G4's capable of supporting the animation program, LightWave 3D by NewTek. This is an advanced animating program used by many professional media industries.

Students usually sign up for 3D Animation because it sounds like a fun and easy class. The computer does not seem as intimidating as a blank sheet of paper and a pencil, so students who feel they lack traditional studio art skills are drawn to this class as well. However, once they get into class they realize that this class isn't ordinary. The class is still fun, but it demands that the student spend time thinking before working.

So how does a fun 3D Animation class promote this concept of higher order thinking?

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First the process of creating an animation using the LightWave 3D program should be explained. The software is actually divided into two programs. Modeler is the program that allows the student to create objects. These objects are like the actors in a play.

The objects are then imported into the second program, called Layout. It is in Layout that simple and complex movements, special effects, textures, lighting and camera angles are manipulated. This arena is like the stage in an auditorium, where the actors created in Modeler will perform. This stage is based on the mathematical concepts of the X, Y, and Z-axes. The center of this universe is the point where these three axes meet, called 0, 0, and 0. All objects move around these axes, in either positive or negative placements.

Students are the directors of their own plays. They determine actors (the objects) and what parts they will play in the production (layout). The students must visualize all aspects of this production before beginning the first stage of modeling. So students are required to sit and think through an animation from beginning to end, deciding on particular special effects, movements, lighting moods, etc. The student then works backwards from the end product to the part where the object must now be modeled.

Even before modeling the object, the student must first visualize the completed object. Then the student condenses the object down to a few basic shapes (oval, circle, square, triangle, rectangle or cone). From these simple basic shapes, which the computer helps create, the student begins to shape this very basic object, manipulating it to his final visualization. This process is similar to modeling a 3D sculpture out of marble or clay. Artists will first clear away the excess and start with some basic shapes, then manipulate the material until the details become clear. Obviously, the more detail a student applies to the object, the more realistic and believable it will look.

Students will often model a very simplistic object but describe it as if the object contains all the detailed elements. This ability to visualize and create detail often takes time to develop. However, this is a very important step in promoting higher order thinking.

In addition, these students must develop the skill to mentally visualize, or think, through an entire process, then backtrack their thinking to make sure the object modeled will perform all the tasks required, once it is moved into layout. This is an extremely complicated task for a student to master, but once the student has, the animation becomes much easier to create and the results are dynamic. Because students constantly build on their skills through each subsequent animation, the constant repetition of tasks increases their ability to think through an animation more quickly and clearly.

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This requirement of thought in creating a 3D-animation project includes the four basic components for facilitating higher-level thinking skills, which are:

- Students are better able to organize the way in which specific thinking processes are engaged.
- Significant opportunities exist for the student to reflect on the thinking they are doing.
- Opportunities exist for the student to practice doing the same sort of thinking in new situations.
- Opportunities exist for collaboration between students in which good thinking attitudes are modeled (Costa, 1991).

Creating an animation forces the student to engage in the following complex thinking processes as well:

Problem Solving

A project is assigned and the student must decide how to solve the "problem" of the assignment. An example is the "Enclosed Space" assignment. The parameters say that it can be any kind of enclosed space, but does not have to be a building; it could be a book bag, file cabinet, etc. The enclosed space must have at lease one opening where the viewer is able to look outside of the enclosed space. There must be three major objects (to be modeled realistically and accurately and play major roles in the animation) and five supporting objects (which do not have to have a high degree of realism, but must be modeled believably). With these parameters, the student must decide and problem-solve how these goals will be achieved. How an object is to move must first be determined before it can be modeled. Modeling determines what kind of movements an object can make.

Decision Making

The student compares advantages and disadvantages of alternative approaches to solving the animation problem. In addition, the student must always keep in mind whether the modeling will take longer than the allotted time for the assignment and whether all the objects work well together in the final animation.

Critical Thinking

This process of developing a cohesive and logical reasoning for the animation and then bringing it to a credible and convincing solution is difficult for the student to focus on. It is more fun to begin modeling the objects rather than think through to the end product. However, the successful students are able to keep this vision in focus.

Creative Thinking

Students are always encouraged to think of the unusual or novel solution to the animation problem. Thinking beyond what first pops into the mind and planning a unique twist to the plot is crucial to making the animation interesting to watch.

As one can see, this is a crash course for many students in stretching some thinking muscles they didn't know they had. However, whether they want to or not, the immediate gratification of the animation process keeps the students striving to

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learn and progress in the class. The side benefit is the development of higher order thinking skills, which seems to transfer for some students into other classes. This "fun" class actually has a hidden agenda in turning my students into mature thinkers!

Can You See It?

One of the most difficult components of modeling an object in 3D animation is the ability to mentally visualize the object to be created. In limited cases, an actual model can be used, allowing the student to actively touch and observe what needs to be modeled. However, with the endless number of objects that a student has to choose from to create, it is impossible to have a physical example of every object. Students must then rely on their ability to make mental images.

Reducing an object down to basic forms, manipulating the form to create a more realistic version, then finally adding the "extras" that make the object convincing is a visual imaging process, often called a visual-spatial ability.

Hand in hand with this ability to mentally visualize an object is the ability to place it in a spatial context. Spatial intelligence is closely tied to and grows out of one's observation of the visual world. However, spatial intelligence is not always dependent on the visual sense (Gardner, 1983). Spatial ability is a general capacity to imagine objects in different perspectives (McGuinness, 1979).

Where does the object reside in space in relation to other objects? How do these objects react to each other and are they in proportion to each other? This spatial acuity does not always come easily to students. It is a skill that must be learned and repeated often. The nature of 3D animation forces the student to constantly make decisions of relationships between objects. These relationships grow from simple size problems in Modeler to more complicated visual elements in Layout (where the objects actually move around and interact with each other). Making estimations, trial and error, and finally corrections are integral to perceiving correctly. Studies have shown that there is clearly an important connection between movement and spatial ability. What isn't known is how this works. (McGuinness, 1979)

3D Animation as an exercise in spatial intelligence draws together a variety of loosely related capacities. The ability to recognize instances of the same element; the ability to transform one element into another; the capacity to conjure up mental imagery and then transform that imagery; the capacity to produce a graphic likeness of spatial information; and the ability to move and twist viewpoints of an element are valuable skills the animator is repeatedly practicing (Gardner, 1983).

Spatial ability has also been linked to aptitude in higher mathematics (McGuinness, 1979). Spatial tasks are problems involving imagery in three dimensions, rather than two dimensions (which would be paper and pencil examples). The capacity to visualize the relationship between the motion of one's body and elements or objects in the world makes it possible to frame space in terms of geometric coordinates (Layout's xyz coordinates). This leads to the ability to construct mental maps of unfamiliar territories. The speed in which a spatial problem is solved, as in the case of animation, is dependent on the capacity to visualize motion in the 3D environment.

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Math has been defined as the science of quantity and space. Quantity and space refer initially to objects and object relations in the world. When students begin imaging in a three-dimensional space, they begin to place that object around an axis. All movements in LightWave are based on the interaction of other objects within the field of xyz and the positive and negative coordinates relating to the axes. These areas of problem solving for the student are obviously math related. However, the student is having too much fun watching his objects spin through space to realize he is learning higher-level math concepts.

Some students have mentioned that they seem to find their math and some aspects of science easier to comprehend after being in animation for at least two years. Even though there are no formalized studies, it could be that the repeated use of the LightWave universe has provided the students with repetitive concrete applications of the math concepts.

Another observation in relation to spatial acuity that bears studying is the improvement of some students who have visual processing disabilities. One student, who had trouble with complex abstract thinking and problem solving skills as well as spatial difficulties, spent two years in my animation class. He continually improved in his ability to think through an assignment and create an animation by being deliberate in his actions, rather than allowing “happy accidents” to occur for him. This student also had spatial difficulties that required his teachers to bubble in the circles on tests that were routinely given. He was unable to accurately darken within the lines. However, after two years in animation, he became able to perform that task himself without aid. The teacher could not explain any other reason for his ability to begin performing this task, other than taking animation. Without additional studies one cannot say with certainty, but clearly the evidence is there that repeated visual and spatial problem solving over the course of two years made an impact on this student.

Getting Motivated

The last important area is not defined by any scientific studies, but rather direct conversations with animation students. Many students signed up for the first animation class because it sounded like fun, but they never seriously thought of this class as a stepping-stone out of high school and into a career. These students would have laughed at anyone suggesting they attend college.

However, some students have become very successful in animating and found that they have a “knack” for modeling objects, visualizing action and putting it all together. They enjoy the challenge of the animation problem and the ability to sharpen their computer skills. It is exciting to see them start to dream of a career, especially one that they will love doing.

This author has had the pleasure of watching students enter an animation class with no direction or thought of what they might do after graduation. Then after two or three years in these classes, they begin to seek out colleges where they can continue their education. What a feeling of satisfaction knowing that this “fun” class impacted a student’s future.

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Thanks to technology, thanks to artists willing to use technology as a tool for creativity, thanks to school districts with vision and thanks to students who take a chance on a new class, lives have been profoundly impacted. This is what education is all about, motivating students, helping students learn about themselves and a skill they can be good at, getting them to think the “big picture” and find a career that they will love. 3D Animation – beyond the fun and into the future!

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