V-Frog

Virtual Frog Dissection

A Tactus Technologies White Paper

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V-Frog: A New Paradigm for Biology Education

V-Frog is an innovative Virtual Reality-based dissection simulator developed using virtual surgery technology. V-Frog delivers a hands-on active learning experience, allowing students to cut, pull, probe, and examine a virtual specimen, as they would a real frog. It has the added benefit of being virtual, meaning students can do things like watch the heart beat, conduct a virtual endoscopy to explore the entire alimentary canal, make the skin transparent to get better insight into the underlying muscular, skeletal, and organ systems as well as a host of other capabilities that are not available with a physical specimen, nor with any other currently available dissection alternative, including multimedia and web-based products.

Dissection and the 21st Century Student

Animal dissection has been an integral part of science education in the United States since its introduction into the classroom in the 1920's as a way of studying Anatomy, Biology, Physiology, and Evolution.[1] The efficacy of dissection is nearly universally accepted and many teachers believe that dissection offers an excellent opportunity for hands-on, exploratory learning and is an essential part of biological education.[2-4] For example, the National Association of Biology Teachers supports dissection and states that "the dissection of animals has a long and well established place in the teaching of life sciences and can illustrate important and enduring principles of biology", reflecting the belief that dissection at the K-12 level is an invaluable teaching tool that cannot be replaced.

However, many students, teachers, parents, and animal rights advocates have expressed strong objections to dissection for moral, ethical, religious, and/or safety reasons. In recent years these individuals have taken a more active role in voicing their opinions regarding dissection which has led to legislation in many states requiring educators to provide an alternative to physical dissection. In 2004, Virginia passed such a law, and most recently (2006), New Jersey passed a similar law.[5] With nearly 6 million dissections performed annually in this country, and as many as 20 million or more worldwide, there exists a need to replace physical dissection with a comparable activity that is both deemed effective by teachers, and acceptable to those who object to physical dissection.[6]

From a societal standpoint, V-Frog fosters environmental stewardship and compassion, and respect for living organisms. Aside from the humane reasons, there have been many published articles which attest to the fact that students using humane alternatives learn equally well and in some case better than student's dissecting/vivisecting animals.[7-10]

Problems with Dissection

As effective as dissection is, there are many problems and concerns associated with it, for example:

- With dissection, there is no integration with the activity and the associated content. Students must continually alternate their attention between the specimen and the supporting text, so information is not presented in context, and learning may be compromised. Further, actions taken in a dissection environment, such as cutting and probing, are not repeatable, so a student has one and only one chance to learn from each action.

- There are health and safety issues associated with dissection. For example, it has been suggested that the chemicals used to preserve the specimens are harmful to anyone who is exposed to them, and scalpel injuries are a real concern.[11]

- Ethical concerns of students, teachers, and others are the most frequently cited reason for seeking alternatives to dissection. Several studies have shown that 1 out of every 3 students is uncomfortable with dissection and that number may actually be much higher.[12-15] Further, advocacy groups like PETA (People for the Ethical Treatment of Animals), the Humane Society, and several others contend that animals are raised in cruel and abusive environments for dissection purposes, and that the dissection specimen industry wreaks havoc on the environment.[11,16]

- There are several instructional problems with dissection such as off-task behavior, workstation preparation and cleanup, and difficulties monitoring and facilitating instruction. Further, lab groups typically consist of a number of students sharing one specimen which is limited to a one time use because they disintegrate over time. The nature of the activity requires that summative assessment and lab reports be evaluated and responded to well after the specimen has been disposed of.

Despite these problems, there are those who believe that dissection is irreplaceable in middle and high school science education, and that multimedia does not present a viable alternative.[3] V-Frog satisfies those on both sides of the argument, presenting students with a lifelike, exploratory environment that integrates content and specimen not available with physical dissection or multimedia alternatives, while addressing all of the learning, ethical, health, safety and instructional issues commonly associated with physical dissection.

State Laws Regarding Choice

Dissection is important because it directly satisfies instructional mandates at both the state and national level. Specifically, dissection allows students to meet objectives under two broad goals: Life Sciences and Inquiry. With respect to Life Sciences, dissection or dissection-like activities are an important part of the curriculum, and are either mandated or strongly encouraged in virtually all of the state and national learning standards.

Even though dissection is nearly universally supported by these standards, more and more states are requiring that alternatives be offered to students. New Jersey, for example, is the most recent state (fall of 2006) to formally enact legislation mandating that alternatives to physical dissection be offered when physical dissection is incorporated into the curriculum.[17] Seven other states (California, Illinois, Florida, Pennsylvania, Rhode Island, Oregon and New York) have similar legislation requiring such an alternative. Others have taken an alternative approach to statutory legislation. Maine, Louisiana, New Mexico, Maryland, and Massachusetts have all adopted Department of Education Resolutions, which effectively mandate that alternatives to physical dissection be offered. Washington, Vermont, New Hampshire, New Jersey, Delaware, Washington D.C., and Michigan, all have legislation pending, or are actively pursuing some form of mandate for offering dissection alternatives.[5,17]

Current Dissection Alternatives

There are currently several commercial alternatives to physical dissection. These alternatives range from physical, molded plastic models, to books, videos, and computer software. The most popular alternatives are computer software. These software applications typically fall into one of two categories: multimedia presentations or enhanced multimedia presentations, which include rudimentary dissection interactivity (e.g., the ability to select a scalpel and use it to reveal a pre-made incision).

The multimedia presentation category includes: Neotek's Frog Dissection Lab; Operation Frog Deluxe, by Tom Snyder Productions (Scholastic); VisiFrog, by Ventura Educational Systems; Boreal Labs' Digital Dissection Series; Drylab, by Tangent Scientific; and Biolab, by Carolina. These products offer very similar functionality, presenting a student with text, artwork, photographs, and in some cases, video clips. These products function more as an enhanced lab book than anything else and offer no ability to affect the models presented. While they present the student with an integrated and self-paced learning environment, they only offer linear and/or restricted learning paths and every student ultimately sees the exact same thing, usually in the exact same sequence.

The second category of enhanced multimedia presentation includes; Digital Frog, by Digital Frog International; CyberEd Dissection Series, by Plato; DissectionWorks, by ScienceWorks; and Frogguts, by Frogguts, Inc. These products allow a student to select a tool, such as a scalpel, and float the tool over a 2D representation of a frog. Clicking the mouse in the right place triggers a video clip or computer animation of the frog being cut. The student does get the benefit of controlling the dissection and seeing content in context, however, none of these products offer any kind of physical simulation of tissue being cut or manipulated, but rather prerecorded renderings and, again, every student sees the exact same sequence or set of images, text and video.

VFrog: A Superior Alternative

The following table presents a summary of the benefits of V-Frog as compared with physical dissection and multimedia alternatives:

	Dissection Platform		
	Physical	Multimedia	V-Frog
Learning Benefits			
Provides an *authentic* experience	X		X
Student can freely manipulate specimen	X		X
Provides an *exploratory* based interaction	X		X
Model-content integration		X	X
Lifelike 3-D specimen	X		X
Actions are *repeatable* for optimal learning		X	X
Student-directed learning path	X		X
Student-centered activity	X	X	X
Nonlinear presentation	X		X
Health and Safety Concerns			
No student exposure to chemicals		X	X
No student exposure to dangerous instruments		X	X
No repeated teacher exposure to chemicals		X	X
Moral and Ethical Issues			
No specimen harm		X	X
No ecosystem harm		X	X
Minimizes student discomfort and resistance		X	X
Instructional Issues			
Instructor can model dissection using projector			X
Activity not constrained to lab environment		X	X
No specimen disintegration		X	X
Assessment can be done in context			X
Lab report and activity contextually connected			X
Direct teacher guidance			X
Objective performance monitoring		X	X
Conducive to efficient classroom management		X	X
Multiple use of specimen/software		X	X
Minimized preparation and lesson closure		X	X
Complies with Life Science standards	X	X	X
Complies with Inquiry standards	X		X

Benefits of V-Frog

V-Frog incorporates the advantages of physical dissection *and* multimedia to provide a never before seen integrated learning environment. Virtual Reality offers a far more sophisticated environment in terms of Constructivist Theory, and opportunities for higher level learning than multimedia alternatives. Multimedia alternatives are either passive, in that the student ultimately watches another person performing a dissection, or only partially active. V-Frog, by contrast, presents the student with a rich, fully interactive environment that allows the student to actively manipulate the model using higher level cognitive functioning while processing content in the context of the model being manipulated, resulting in the potential for higher level learning and more in-depth understanding.

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