

MULTIMEDIA OCCUPATIONS:

The Convergence of Art and Technology in the Age of New Media

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Los Angeles Community College District

Workforce Development Program

By

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EXECUTIVE SUMMARY

Multimedia is an area that is particularly challenging from a workforce development perspective because of the rapid technological and market changes that affect education and training requirements. However, multimedia also represents a growing area of employment especially in the Los Angeles region. This study focuses on broad industry trends, changing occupations and skills, employment outlook, and workforce development issues relevant to multimedia. In so doing, the study supports the continuing efforts of state-wide workforce development initiatives at the California Community Colleges as well as arts and multimedia curriculum currently offered at the community colleges in the Los Angeles Community College District.

Some of the report's findings are summarized below:

- There is really no single occupation that is representative of multimedia. This is because multimedia content, like other creative products such as movies or music recordings, generally requires a team of professionals to make them. The composition of the multimedia project team can vary according to the size and scope of the project. However, multimedia skills can be grouped into three broad categories: 1) project management, 2) creative/design, and 3) technology/ computer programming.
- The report identifies shared skills across different industries - aerospace, architecture/visualization, web site design, video games, toy design, and digital visual effects. Project management, graphic design, and animation skills are applicable across all the different industries. In comparison, video and audio production skills are less common across industries.
- Employment outlook for multimedia professionals is generally positive. In the Los Angeles region, there were 3,870 Multimedia Artists and Animators employed in 2005, an almost 85 percent increase over 2000 employment figures. In addition, Los Angeles' share of total employment for Multimedia Artists and Animators in the state increased to 60 percent in 2005 compared to about 40 percent in year 2000.
- Because the Los Angeles region has a growing concentration of new media companies such as digital visual effects companies, video game publishers, visualization studios, and

web-site developers that hire Multimedia Artists and Animators, employment in the multimedia and animation occupation has been growing in Los Angeles even though it has declined nationally.

- The average annual wages for Multimedia Artists and Animators in the Los Angeles region were \$80,870 in May 2005, almost double the average annual wages (\$41,420) for all occupations. Multimedia Artists and Animators earned more than computer programmers (\$71,100) and architects (\$70,061) in the Los Angeles region.
- The community colleges in the Los Angeles Community College District offer courses that are relevant to multimedia and animation occupations. A survey of program and curriculum information identified 231 multimedia and animation related courses that are currently offered at the District's nine community college campuses.

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I Introduction

This report examines multimedia occupations and provides updated information on multimedia skills in the context of workforce development considerations for the Los Angeles Community Colleges. Although multimedia has been around for many years, lately it has been associated with the emerging field of “new media”¹ because of the increasing integration of computer technology, telecommunication, and the Internet in the production of multimedia products and services. Multimedia products and services are used for a variety of purposes by public and private organizations: education, training, marketing, commerce, entertainment, and communication. Because of the growth in multimedia applications and its impact on employment and business opportunities, local economic and workforce development organizations have dedicated valuable resources to attract and sustain multimedia professionals and related industries.

California Community Colleges, recognizing the importance of multimedia in the state’s economy, has developed a statewide program, the Multimedia & Entertainment Initiative (MEI). This program has six regional centers and promotes relationships between employers and colleges throughout the state in order to assess industry needs and to develop effective educational and training programs in multimedia. At the local level, the Los Angeles Community College District’s program – CreateLA – supports programs that target Cinema, Television, Video, Broadcasting, Music, Theatre, Animation (traditional and digital) and

¹ Batt et. al. uses definition of new media industry provided by the New York New Media Association, which states: “The New Media industry combines elements of computing technology, telecommunications, and content to create products and services which can be used interactively by consumers and business users.” see Batt, Rosemary, Susan Christopherson, Ned Rightor, Danielle Van Jaarsveld, (2001). “*Networking: Work Patterns and Workforce Policies for the New Media Industry.*” Economic Policy Institute: Washington D.C.

Multimedia. The nine community colleges in the Los Angeles Community District offer 231 different courses that provide training in one or more skill areas of multimedia and animation. These courses range from figure drawing to computer programming, and are offered through various departments and programs, including art, visual communications, new media, multimedia, and computer science and information technology.

Multimedia is an area that is particularly challenging from a workforce development perspective because of the rapid technological and market changes that affect education and training requirements. This study focuses on broad industry trends, changing occupations and skills, employment outlook, and workforce development issues relevant to multimedia. Thereby, the study supports the continuing efforts of workforce development initiatives as well as arts and multimedia programs at the local community colleges. Furthermore, this study provides updated labor market information that is useful in supporting the decision-making process with respect to existing and future multimedia programs at the community colleges

A. Objectives

This report has three objectives: 1) identify multimedia occupations and define them in terms of each occupation's skills; 2) analyze employment outlook for Multimedia Artists and Animators,² and 2) determine shared multimedia skills across industries and explore cross-industry employment opportunities. Since the range of industries that are involved in

² For purposes of analyzing employment trends, we use the occupational category – Multimedia Artists and Animators - as defined by the U.S. Bureau of Labor Statistics. This is a broad occupational category that includes different occupations but the government does not provide employment statistics for more detailed occupations. In the report, we provide detailed occupations that fit within the category of Multimedia Artists and Animators.

multimedia is expanding, employment and career opportunities outside of traditional areas of multimedia – e.g., publishing, advertising, and education – are particularly relevant from a workforce development perspective. Therefore, this report explores in some detail issues of employment/career mobility across industries for multimedia artists and professionals.

B. Sources of Data

In producing this report, research activities conducted include literature review, Internet research, secondary data analysis, and interviews. Publications and web-based information used in this study are listed in the Appendix 6.

The Occupational Employment Statistics (OES) from the U.S. Department of Labor was the primary source of occupational data. The Department of Labor uses the 2000 Standard Occupational Classification (SOC) system to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating employment and wage data. The SOC system includes 23 major groups, 96 minor groups, and 449 broad occupations. Multimedia Artists and Animators (SOC 27-1014) are classified under the major group, Arts, Design, Entertainment, Sports, and Media Occupations, and under the minor group, Artists and Design Workers. Because the Department of Labor collects occupational data from firms using a survey, OES data does not cover freelance (independent contractor) workers. For multimedia, where freelance workers are common, this omission may result in significant underestimation of employment and wage statistics.

Industry statistics for U.S., California, and Los Angeles County were extracted from the County Business Pattern data published by the U.S. Census Bureau. This data was used to present industry employment and

establishment statistics according to the North America Industry Classification System (NAICS).

Interviews were conducted with representatives from firms that have business establishments in the Los Angeles area. The participants were given interview questions and a description of multimedia skills prior to the actual interview. In a phone interview that lasted approximately 30 minutes, the participants were asked to identify multimedia skills that were relevant to their business and to discuss workforce issues including training and recruitment. A similar approach was applied in interviews with faculty and administrators at the LACCD. While the report reflects the contributions provided by interview participants, no statement in the report can be attributed to any one individual. A list of interview participants is provided in Appendix 5.

II. What is Multimedia?

Most authorities on multimedia define multimedia in broad terms as products, services, and content that integrate digitally manipulated text, photographs, graphic art, animation, sound, and video elements and have a built-in dynamic user interface (Vaughn, et.al., 2001; England and Finny 2002). The user interface generally defines the parameters for interactivity – i.e., the user’s ability to control and manipulate various visual and sound elements of the multimedia content as well as the sequence and intensity of user experience. Interactivity ranges in intensity from passive participation to active manipulation. In the case of passive participation, interface is designed such that users are allowed to simply experience multimedia content without much interactivity, e.g., informational video or CD-ROM. On the other hand, a dynamic user interface is designed to allow users to manipulate multimedia content. Interactivity-intensive multimedia include educational CD-ROMs that

Multimedia integrates text, photographs, graphic art, animation, sound, and video elements.

allow students to control the sequence of lessons, video games that allow users to manipulate certain elements of the game or to interact with other gamers online, web-based commerce that allow consumers to view and purchase products, and interactive music that allows users to mix and record their own music. As digital technologies (computer hardware and software) and the Internet become more powerful and sophisticated, a dynamic user interface is becoming even more central to the multimedia experience. Moreover, these technological developments bring traditional multimedia closer to new media. The convergence of multimedia and new media is illustrated in the following types of new products and services.

- **Online Interactive Games:** The video and computer games industry is a multi-billion dollar industry. It has successfully integrated the multimedia concept of interactivity with computer generated 3D environments and characters in complex action games that can be played on the Internet.
- **Design Visualization (DV)**³: Design visualization is a digital representation of a design concept that can be as simple as a 2D computer drawing or as complex as an animated 3D computer model. Design visualization illustrates how the design will look, work, and interact with other elements. Design visualization is used in architecture to visualize buildings and spaces and allows architects and engineers to make decisions about how to improve the design. It is also used to communicate design concepts to clients. Design visualization is also used in large scale public works projects and consumer product development. Tools in design visualization include Adobe Acrobat's 3D Interactive

³ Definition is based on the Federal Lands Highway Division – Design Visualization Guide. <http://www.epl.fhwa.dot.gov/manuals/dv/>. Discussion of other tools are also available on the web site.

Display that allows the incorporation of 3D Microstation files and enables users to interact with the model or play pre-defined animation.

- **Web-Based Marketing and Commerce:** According to the U.S. Census, sixty-two million households, or 55 percent, had Internet access in 2003, up from 50 percent in 2001.⁴ Of the adult Internet users (18 years and above), 78 percent retrieved information on products and services online, 36 percent played games, and 21 percent viewed television shows and movies. Today, almost every company has a web site to provide information and sell products online. The design and development of these web sites is based on multimedia design principles, skills and tools.

These are only few examples that illustrate how multimedia is integral to emerging markets in entertainment and e-commerce. However, multimedia has broader applications in education, training, entertainment, business and public sphere. Educational and instructional multimedia include digital encyclopedias and classroom resources such as reading, math, science, and playtime activities. With computer tools, students can also create their own multimedia in the classroom (Vaughn, 2001). In business, multimedia is used in marketing, advertising, training, product demonstrations, and workflow management. In addition to video games, multimedia in entertainment includes interactive television and interactive music.

Multimedia content is generally distributed through CD-ROM/DVD, web sites, kiosks, interactive television, and various electronic handheld

⁴ The US Census Bureau (October 2005). Computer and Internet use in the United States, 2003. <http://www.census.gov/prod/2005pubs/p23-208.pdf>

devices. Whatever the end product is, multimedia production requires bringing together a diverse set of creative and technical professionals.

III. Multimedia Occupations and Core Skills

There is really no single occupation that is representative of multimedia. This is because multimedia content, like other creative products such as movies or music recordings, generally requires a team of professionals to make them. Even though one person could develop and implement a multimedia project, most multimedia content is created through collaboration between several creative and technical professionals. A multimedia project team generally includes at least a project manager, an art director, a graphic designer, an animator, a sound engineer, a videographer, and a computer programmer. Various individuals on the team are responsible for creating different elements, e.g., animation, graphics, and sound. All the elements are then integrated to produce the final multimedia content.

Multimedia content is created by a team of professionals - project manager, art director, graphic designer, animator, sound engineer, videographer, and computer programmer.

The composition of the multimedia project team can vary according to the size and scope of the project. Moreover, as multimedia expands into new media areas, the team composition reflects the technology used in the new media areas such video game design and web site development. Although it is difficult to standardize a set of occupations that is applicable to all multimedia projects, multimedia skills can be identified and grouped into three general categories: 1) project management, 2) creative/design, and 3) technology/computer programming. Any multimedia project would involve one or more skills from each category.

A. Project Management

The creation of multimedia product, services, and content is typically organized as a project. A project can be organized as a one-time business

investment or it is organized within an on-going firm. In multimedia projects that are organized within a firm, the project team may be made up of independent contractors or employees of the firm or both. For example, in a game development firm, a project team is assembled around a specific game title. The members of this team are employees of the firm and may work on other titles at the same time. However, once the game project is completed, the team is dissolved and the members move onto other projects. In this case, creation and dissolution of the project team occurs within the firm. In other cases, the firm may contract parts or all of the project to one or more independent contractors. When the project is completed, the contractual relationships between the firm and the independent contractors are also dissolved.

The development of multimedia content is typically organized as projects.

Project organization has several unique characteristics that set it apart from traditional mass production. Because projects are temporary, there is an explicit assumption that production relationships will terminate with the completion of the project. Projects usually involve a multidisciplinary team that brings together different sets of knowledge and skills. Team members can come from different divisions or departments within the firm or they are independent contractors assembled for the specific project. Once the project is completed, the members of the team move on to different projects but rarely does the entire team move onto other projects as a team.

Project management is critical to project organization, but it usually gets less attention than creative or technical functions. A project manager is responsible for project development and implementation, which means he/she must be a team leader and understand the entire project in terms of its vision and goals. It is the responsibility of a project manager to make sure that individuals within the team have the appropriate skills and experiences and are brought in at the appropriate stages of the project.

The project management skills that are common across different industries include: 1) ability to develop and implement a production budget and schedule; 2) effectively manage the project team and clients; and 3) ability to manage unexpected outcomes and changes. However, because project managers are required to be familiar with the specificities of production, project managers tend to rise up the ranks within the industry. They may have been a specialist in graphic design, animation, video production or computer programming. Therefore, project managers may have had little or no training in project management or business strategy. As a result, employers generally have difficulty finding qualified project managers.

PROJECT MANAGER	
Other titles ⁵	Producer Program Manager
Responsibilities	Project Managers are responsible for the overall development and implementation of the project. Project Managers acquire, organize, and coordinate production assets (text, graphics, animation, visual images, sound, video, etc.). They manage and control the project budget, timeline, and quality levels. In addition, Project Managers interact with clients and effectively communicate and negotiate project goals and outcomes.
Skills	Extensive creative and/or technical backgrounds. Understands each project element and how the elements fit in the production process. Understands project management principles (budget, scheduling, client management, staffing). Understands processes and context of specific products and industries. Experience in business strategy and development.
Tools - Software	TestTrack, Excel, PowerPoint, Word, MS Project.

⁵ Occupational titles are not standardized across industries. Therefore, we are listing other titles used by different industries for what is essentially the same occupation.

The creative team is responsible for what users see, hear and experience.

B. Creative/Design

The creative or design elements of a multimedia project are text, graphic design, animation, visual images (photographs, computer generated images), and video. Each of these elements is created by a creative/design specialist. Occupational titles that fall within the category of creative/design specialists are director, graphic designer, interface designer, 3D artist, animator, video specialist, sound specialist, and game developer. While these titles are fairly well understood within each industry, there are variations in specific functions and skills. This results in the lack of a standardized set of occupational creative/design titles for multimedia.

Creative/design specialists are responsible for the user's experience of the multimedia product or service. The works of these specialists are commonly referred to as "production assets," which are managed by the project manager. The creative or design elements and the core skills that are required to produce them are summarized below.

- **Text:** Text is one of the common elements in multimedia content. It can be original narratives, dialogues or even key words (e.g., menus on web sites) written specifically to enhance the user's multimedia experience. Text can be also scanned from existing publications. Design considerations include type, letter style, size, color, and placement. A designer may use a drawing tool to modify or smooth out the edges. Text is different from authoring, which is a process for creating and designing content in Multimedia. Authoring usually refers to computer programming functions in video game and web site development.
- **Graphic Design:** The visual effectiveness of multimedia content is partly dependent on graphic design. Graphic designers consider the layout in terms of how well different visual elements will work

together to enhance the experience of the user. Graphic design skills include drawing, painting, and image manipulation, which are now done with various computer software programs. Drawing and painting software programs allow graphic artists to draw with precision, effectively manage large digital collections, and encourage experimentation.

- **Visual Images:** With advances in 3D graphics software, computer generated images are becoming much more common than they used to be. 3D modeling not only allows artists to create complex characters and environments, it also allows for the creation of animation, movement, and virtual experiences. 3D modeling skills include making wireframes by choosing from basic and complex shapes, rendering (a process of converting an outline image into a fully-formed, three-dimensional image), and adding color and texture to surfaces. Animating 3D characters requires enormous amounts of computing power and sophisticated computer programming. A recent development in 3D animation is a “motion capture” technique that uses actual actors in special suits with strategically placed sensors where the actor’s movements are filmed and converted digitally.
- **Animation:** Much of the animation is done digitally using a computer software program. However, even animators who use computer tools rely on traditional core skills, which are character drawing, storyboarding, and illustration.
- **Digital Video:** Video clips can enhance multimedia content in ways that no other multimedia element can. Producing a video clip is similar to producing a short movie. It requires a similar set of skills: storyboarding, filming, lighting, and editing. Other specialized skills that are usually done with computer software

programs include digitizing, video compression for computer playback, creating special effects, and authoring.

- **Sound:** Music, voice-over, and sound effects are important elements in multimedia content particularly in interactive programs such as video games and educational programs. Sound elements are usually created by a sound designer and/or a sound engineer. The skills needed to produce sound for multimedia include recording, digitization, editing, and mixing.

It is worth noting that computer software programs are critical production tools in all the creative/design specializations. The following computer programs are commonly used by creative/design specialists. See Appendix 1 for an expanded list of common software titles in multimedia.

- **Adobe Photoshop:** used for retouching, editing, and compositing bit-mapped images (array of color values specified for each pixel). Specifically, Photoshop's basic functions include removing color cast (unnatural predominance of one color) from scanned image, removing unwanted background objects from photographs, superimposing text on a picture and giving a 3D appearance, creating collages, and changing resolution for display on a monitor. Images for the web are produced in Photoshop's web graphic application - ImageReady.
- **Adobe Illustrator:** used to produce vector graphics (images described in mathematical terms in contrast to bitmapped images) that can be edited and transformed. Primary functions are drawing technical diagrams and illustrations. It is also used to fill in shapes with complex color gradients and produce an appearance of drawing done with traditional materials such as charcoal, watercolor, and ink.

Computer software programs are critical production tools in all the creative/design specializations..

- **Macromedia Flash:** used for creating animation with interactive features (allowing users to activate and manipulate the characters). More than an animation program, Flash include ActionScript, which allows for complex computations and exchange of XML (Extensible Markup Language) data.
- **Autodesk 3D Studio Max:** used for creating 3D graphics and animation. Basic features include animation, modeling, UV mapping, skinning, scripting language, rendering, lighting, and visualization.
- **Macromedia Dreamweaver:** used for web site design and management. Basic functions include formatting text and images using HTML (Hypertext Markup Language), adding links, tables, forms, and images, and incorporating dynamic time-based behavior and interaction using JavaScript.
- **Adobe Premiere:** used to capture video, edit video and sound, apply effects and transitions in real-time, and export the completed clip in different formats (e.g., digital for CD-ROM or web distribution).
- **Autodesk Maya:** used for character animation, models, and environments that incorporate sophisticated textures maps, creating clothing, fur, or hair, and produce compositor ready render layers. Works with Photoshop and Illustrator as well as CAD systems.

ART DIRECTOR	
Other titles	Multimedia Designer Web Developer
Responsibilities	Art Directors are responsible for the overall creative vision and art content of the project, including animation, graphics, video and sound. They work closely with project managers. In some cases, they may also perform project management functions and be responsible for meeting budget and schedules. Art Directors often come from production backgrounds and have in-depth knowledge and experience in one or more design areas.
Skills	Knowledge of tools and techniques used to create and manipulate various visual and sound elements. Knowledge of typography, graphic design, color theory, illustration, and 2D/3D animation. Ability to work with a variety of specialists. Ability to accomplish tasks within scheduled deadlines and budgets.
Tools	Photoshop, Illustrator, Zbrush, PowerPoint, 3D Studio Max, Flash, Maya, scanning devices.

GRAPHIC DESIGNER	
Other titles	Designer
Responsibilities	Graphic Designers are responsible for creating original art work with visual style, design and layout that is appropriate to the project's concept and goals. They create screen layouts, menus, icons and symbols, logos, charts and diagrams. Graphic Designers are also technically competent with a variety of electronic tools and techniques.
Skills	Understands fundamentals of visual communication and design, including color theory, composition and iconography (the use of symbols). Understands storyboarding techniques. Knowledge of image processing tools such as a scanner. Knowledge of computer painting and drawing programs. Ability to create artwork that conforms to the style and content specifications provided by the project's art director or producer. Ability to understand various audiences and select design style most appropriate for that audience.
Tools	Adobe Photoshop, Adobe Illustrator, Zbrush, PowerPoint, scanning devices and applications.

INTERFACE DESIGNER	
Other titles	User Interface Artist
Responsibilities	Interface Designers are responsible for creating the product environment and determines how the user will interact with the program. They provide users access to text, graphics, animation, sound, and video. Interface Designers devise navigation pathways and content maps, and set the parameters for how the screens and dialog boxes are interrelated and will flow together. They design icons and other visual symbols and cues.
Skills	Strong graphics design knowledge and the ability to apply it to develop creative and innovative design solutions. Understands web design processes and web environments. Ability to conceptualize, present and execute ideas within a tight project schedule. Ability to understand the capabilities and expectations of the product's potential users. Basic knowledge of cognitive psychology (how people think and perceive). Ability to be work well with other specialists.
Tools	Adobe Photoshop, Adobe Illustrator, Flash, Maya, 3D Studio Max.

3D COMPUTER ARTIST	
Other titles	3D Environmental Artist 3D Character Modeler 3D Texture Artist
Responsibilities	3D computer artists develop realistic models and textures for high-poly characters, backgrounds, sets, and environmental elements using computer programs.
Skills	Superior eye for light, shade, color and detail in creating texture maps. Understands form, shape, structure, and silhouette in regard to modeling. Skilled in illustration, modeling, texturing, animation, concept drawing. Modeling high-resolution objects in 3D, rigging, animating, lighting and compositing. Ability to use current 3D computer programs.
Tools	Adobe Photoshop, Maya, 3D Studio Max, Flame.

ANIMATOR	
Other titles	Character Animator Particle Animator Effects Animator
Responsibilities	Animators create two-dimensional (2D) and three-dimensional (3D) human and non-human characters and effects (such as water, smoke, shadows or fire) and illustrate them in motion. Three dimensional (3D) images are created using computer animation or modeling programs resulting in a more complex animation and effects.
Skills	Ability to draw characters and objects with emphasis on body movement, physical form, texture, and weight. Ability to illustrate effects. Understands storyboarding (story development and interpretation, animation process such as timing & layout). Ability to use scanning and image manipulation tools. Ability to use computer graphics software programs. Willingness and ability to work effectively with other creative and technical specialists.
Tools	Adobe Photoshop, Maya, 3D Studio Max, Lightwave, Renderman, Houdini Escape.

VIDEO SPECIALIST	
Other titles	Video Producer
Responsibilities	Video Specialists often perform producer, director and editor functions to create appropriate video footage for multimedia. They are also involved in acquiring existing video footage and editing it. Depending on the project, a Video Specialist may be just one person with a camcorder. On another project, a Video Specialist may be in charge of a team of videographers, sound technicians, lighting designers, set designers, grips, gaffers, script supervisors, and actors, much like a movie or television producer. Video for multimedia must be converted to a digital format before editing, manipulation, and for playback by computer or other electronic media.
Skills	Knowledge of composition such as proper use of lighting and perspective. Understands video recording tools and techniques, including lighting, color, resolution and motion steadiness. Knowledge of computer software programs used to edit and manipulate digital video. Understands compression/decompression techniques. Understands blue screen video shooting.
Tools	Adobe Photoshop, Combustion, Fire, Flame, Lustre, Final Cut Pro, Premiere, Windows Media, QuickTime, Flash and Real Media.

AUDIO SPECIALIST	
Other titles	Sound Producer Sound Designer Sound Engineer
Responsibilities	Audio Specialists are responsible for designing and producing music, voice-over narrations, and sound effects.
Skills	Knowledge of sound design, studio recording techniques, and processing tools. Understands how sound fits into the project. Ability to use computer sound tools, including microphones, tape formats and high-quality recording techniques. Willingness and ability to be adaptive and improvise when necessary. Willingness and ability to work under tight time schedules.
Tools	Sound recording and mixing equipment and software applications such as ProTools.

GAME DEVELOPER	
Other Titles	Game Designer Project Manager
Responsibilities	Game Developers will oversee the entire project including concept and design, storyline, technical requirements, sketches, basic element construction, different phases of development and testing, budget and project timelines. They work with writers, music composers, artists, voice-over actors, and computer programmers.
Skills	Knowledge of design concepts and story development. Ability to apply design, animation, and other visual and sound elements to game development. Knowledge of different computer hardware and game platforms. Knowledge of computer applications and tools. Ability to manage team of artists and technical professionals.
Tools	Adobe Photoshop, Maya, 3D Studio Max.

C. Technology: Computer Programming⁶

Advances in digital technology tools have stimulated enormous progress in the capability of multimedia artists to create more complex environments and dynamic user interfaces.

The creation of multimedia content as illustrated above is achieved using computer technology and other digital technological tools (digital video and recording). The computer programming function is growing in importance in multimedia due to several factors: 1) increased complexity and diversity of technologies and applications used in multimedia, 2) increased demand for innovative products that push the technological capabilities, and 3) the need to meet the specific requirements of complex production systems.

Therefore, computer programming in multimedia is increasingly critical to the seamless integration of various visual and sound elements. It also extends the functionalities of computer tools and production infrastructure by customizing existing software or developing proprietary applications.

⁶ Other technology occupations not covered in the report but are integral to multimedia projects include information technology specialists and network administrators. Information technology specialists are responsible for data processing, storage, management and dissemination. Network administrators or system administrators maintain hardware and software of the system.

HTML OR JAVASCRIPT AUTHORS	
Other Titles	Web Page Designer Computer Graphic Artist
Responsibilities	HTML or JavaScript Authors create web pages that contain text, graphics, animation, sound and video. They design and develop "links" and special hypertext or icons that take users to other web pages or to another Web Site. Sometimes HTML and JavaScript programming is performed by computer graphic artists.
Skills	Ability to create and edit in Hyper Text Markup Language (HTML). Knowledge of Common Gateway Interface (CGI) scripting codes. Knowledge of graphics applications and techniques. Basic skills and knowledge of TCP/IP and Networking. General awareness of the issues concerning the Internet and the World Wide Web, such as download time/bandwidth, content driven pages, and graphics versus text.
Tools	HTML, CSS, XML, Java Script, Perl, C, Cold Fusion, UNIX shell scripts.

COMPUTER PROGRAMMER	
Responsibilities	Computer programmers enable all the components of a multimedia product to work together seamlessly and produce the desired effects. They make decisions about the appropriate platform and programming language for the project. They improve capabilities of existing software applications by building extensions. Multimedia for the Web requires programmers to work in HTML (Hypertext Markup Language) to create 2D products, and VRML (Virtual Reality Modeling Language) for 3D products.
Skills	Expert knowledge of programming tools and authoring software packages, including their strengths and weaknesses. Knowledge of computer operating systems (Windows, Linux, Unix). Knowledge of data structures, algorithms, and program debugging. Understanding of the Internet and the World Wide Web. Ability to work with other specialists and contribute to the project in a team setting.
Tools	C, C++, OpenGL, MacOS, Assembly, Windows, Maya, HTML, MaxScript, Perl, PHP, Python, SQL, XML, UNIX.

SOFTWARE ENGINEER	
Other titles	Software Analyst Programmer Analyst Computer Scientist
Responsibilities	Software engineers maintain and develop computer applications for the project. They write computer codes to develop computer applications that can increase production capacity and improve graphical rendering quality and performance. They conduct research and development, tests, and debugging.
Skills	Advanced programming ability in C/C++. Knowledge of Object Oriented Design and Programming. Development experience in Windows, Linux, or Unix. Expert knowledge in computer graphics and graphical rendering. Strong math skills – experience in 3D graphics, numerical analysis, optimization. Ability to get the most out of graphics acceleration hardware. Ability to work well with colleagues and willingness to learn from and contribute to the team.
Tools	C, C++, JAVA, MATLAB, DirectX, OpenGL, Swig, Visualization Tool Kit (VTK)

III. Shared Skills and Cross-Industry Mobility

Today, multimedia applications are expanding across disciplines and industries and becoming integrated with “new media” sectors. Because multimedia has the power to enhance human interactivity and deliver and communicate information effectively, multimedia in various formats (CD-ROM, kiosks, interactive television, web sites) are used by public and private organizations in education, business, government, and entertainment. Advances in digital technology tools have stimulated enormous progress in the capability of multimedia artists to create more complex environments and dynamic user interfaces. These developments have also led to new uses of multimedia such as digital visualization, interactive video games, and sophisticated digital visual effects, which are all part of the emerging “new media” sector.

The evolution and growth of multimedia may indicate expansion of employment opportunities for multimedia professionals. This section addresses two related questions: 1) are there shared skills that are relevant to different industries? and 2) do shared skills lead to career and employment mobility across different industries?

Crossover skills are shared skills across different industries, while crossworking indicates inter-industry employment mobility.

Previously, the California Community Colleges sponsored a study on high-technology occupations in the motion picture and television industry, in which the term “crossover skills” was introduced.⁷ Crossover skills were defined as high-technology skills in the motion picture and television industry that were also used in production of products and services in other industries. Therefore, crossover skills are shared skills across different industries. The same report also defined another term “crossworking” to mean employment mobility across industries.⁸ In other words, an individual will work in different industries by applying a similar set of skills.

Table 1 illustrates the prevalence of Multimedia Artists and Animators in various industry sectors. According to the U.S. Department of Labor, Multimedia Artists and Animators were employed in 55 different U.S. industries.⁹ Of these 55 industries, the Motion Picture and Video

⁷ Lee, Kathleen and Kathleen Milnes (2005). Crossworking: High-Tech High-Tech Motion Picture and Television Workers in California - Exploring Employment Patterns and Industry Cross-Over Opportunities. Entertainment Economy Institute. This report was sponsored by the Center of Excellence located at the Los Angeles Community College District, the statewide Multimedia & Entertainment Initiative (MEI), and the California Department of Education.

⁸ See Crossworking Report (2005) and Entertainment Industry Trend Report: Labor Market Analysis (June 2004). The Entertainment Industry Trend Report, based on detailed data from California Employment Development Department, showed that almost half of the motion picture and television industry workforce worked outside the industry while working in entertainment.

⁹ The U.S. Department of Labor defines Multimedia Artists and Animators broadly as skilled professionals who “create special effects, animation, or other visual images using film, video, computers, or other electronic tools and media for use in products or creations, such as computer games, movies, music videos, and commercials.”

Industries, Advertising and Related Services, Software Publishers, Specialized Design Services, and Internet Publishing and Broadcasting were among the top 10 industries employing Multimedia Artists and Animators. Multimedia Artists and Animators earned relatively high wages. The annual median wages ranged from \$39,000 to \$58,000 in 2002.

Table 1. Top 10 U.S. Industries Employing Multimedia and Animation Artists

NAICS	Industry	Percent of Total	Annual Median Wages
5121	Motion Picture and Video Industries	1.70	\$58,900
5418	Advertising and Related Services	1.31	\$46,520
5112	Software Publishers	1.22	\$58,290
5414	Specialized Design Services	1.12	\$45,080
5161	Internet Publishing and Broadcasting	0.84	\$48,830
5151	Radio and Television Broadcasting	0.70	\$39,250
5415	Computer Systems Design and Related Services	0.48	\$44,040
5152	Cable and Other Subscription Programming	0.43	\$49,360
5181	Internet Service Providers and Web Search Portals	0.41	\$51,310
5191	Other Information Services	0.37	\$46,080
3346	Manufacturing and Reproducing Magnetic and Optical Media	0.31	\$47,870

Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, 2002.

Table 2 identifies multimedia skills that are shared across different industries. This table does not represent the entire spectrum of multimedia uses across industries but serves as an illustration. There will be variations at the individual firm level in terms of the actual multimedia

skills employed, which tends to be a function of project characteristics (e.g., scope, purpose, commercial value of output). Nevertheless, the table shows that project management, graphic design, and animation skills are applicable across all the industries. In comparison, video and audio production skills are less common across industries.

Table 2. Core Multimedia Skills Shared Across Industries

	Aerospace	Architecture/ Visualization	Web Site Design	Video Games	Toy Design	Digital Visual Effects
<i>Project Management</i>	●	●	●	●	●	●
<i>Graphic Design</i>	●	●	●	●	●	●
<i>Interface Design</i>	●	●	●	●		
<i>Animation</i>	●	●	●	●	●	●
<i>Video Production</i>	●					●
<i>Audio Production</i>	●			●		●
<i>Computer Programming</i>	●	●	●	●		●

It is important to note that Table 2 does not represent actual employment mobility across different industries. In other words, the table does not show whether an individual with 3D modeling skills who has worked primarily in the video games industry is likely to find employment in architecture or in the aerospace industry. Without empirical data, it is difficult to validate and analyze employment mobility across different industries.¹⁰ However, there are different factors and issues that might

¹⁰ Detailed data on individual employment patterns over time is required to do employment mobility analysis.

facilitate or hinder cross-industry mobility for multimedia professionals. These are discussed below.

- **Multimedia for General Audience:** When multimedia's function is to communicate ideas and information to a general audience or to the public, there are less barriers to cross-industry employment. For example, a manufacturing company may hire a multimedia developer (or a team of artists and technical professionals) to develop an informational program to be distributed on the company's web site for marketing purposes. In this case, the multimedia team is not required to have prior knowledge of the industry or its product. This is similar to production companies that make television commercials. The production team is made up of specialists in various areas of camera, lighting, production design, and so on, but their client base is diverse.
- **Technology Functions:** When the skills are more technical than artistic, then the skills are transferable across more industries. The production tools in multimedia are mainly computer applications that include pre-packaged titles such as Maya and proprietary extensions and programs developed in-house. Computer programmers and software engineers support the work of multimedia artists by maintaining and extending the capabilities of production tools. Their computer programming skills can be applied to develop applications to support production functions in other industries. Therefore, there is a greater likelihood of cross-industry mobility for computer programmers and software engineers than for animators.¹¹

¹¹ Although computer network administrators and systems analysts are not covered in this report, they are central to multimedia production infrastructure. Their skills are even

- **Multimedia as Decision-Making Tool:** When multimedia is used as a decision-making tool for professionals within an industry, the multimedia project team is required to have industry specific knowledge. 3D modeling in architecture and video games is an example that illustrates that a shared skill may or may not result in cross-industry mobility. The same 3D modeling skills are used to create characters in video games and buildings in architecture. However, video games are used by a general audience whereas architectural models are used by architects for making design decisions. Therefore, 3D modeling in architecture is usually done by architects. These architectural modelers move into video games and entertainment but rarely vice versa.
- **Industry Knowledge:** When multimedia skills are applied to developing products and services that have industry specific requirements, cross-industry mobility is restricted. Project managers working in different industries use common project management skills – i.e., budgeting, scheduling, production asset management. However, most effective project managers possess industry specific knowledge that allows them to be better decision-makers. Industry specific knowledge is acquired primarily through extensive experience in the industry.

IV. Employment Outlook

Nationally, employment for Multimedia Artists and Animators has declined over the years. Table 3 shows that between the years 2000 and 2005, employment in this occupation declined by 7,330 in the U.S.

more broadly applicable than computer programmers and software engineers described here because the computer systems much more standardized.

However, over the same period, California's employment for Multimedia Artists and Animators increased by 1,120 to reach 6,530 in 2005. For this occupation, California held the largest concentration of employment in the nation with 27 percent of the total U.S. employment in 2005. New York was a distant second with 12 percent.

Employment for Los Angeles Multimedia Artists and Animators is growing despite negative employment growth nationally.

In the Los Angeles region, employment for Multimedia Artists and Animators grew even faster than the state as a whole. In 2005, there were 3,870 Multimedia Artists and Animators employed in the region, an almost 85 percent increase over the year 2000 employment figures. In addition to the large growth in employment, the Los Angeles region gained a larger share of employment in Multimedia Artists and Animators. In 2005, Los Angeles' share of total employment for Multimedia Artists and Animators in the state was slightly less than 60 percent compared to about 40 percent in year 2000. Some of the increase is attributed to changes in geographic boundaries that define the Los Angeles metropolitan division. In 2005, Glendale was added to the 2000 definition that previously only included Los Angeles and Long Beach.¹² Nevertheless, Multimedia Artists and Animators are experiencing strong employment growth in the Los Angeles region.

¹² Glendale is home to many animation companies and related employers.

Table 3. Employment in Multimedia Artist and Animator Occupations

	Year 2000	Year 2005	Percent Change 2000-2005
United States	31,120	23,790	-24 %
California	5,410	6,530	21%
Los Angeles-Long Beach-Glendale, Metropolitan Division	2,090*	3,870	85%

Source: U.S. Department of Labor, Bureau of Labor Statistics. *Employment figures for California-Long Beach Metropolitan Division.

Nationally, the industries with the highest level of employment for Multimedia Artists and Animators included entertainment as well as non-entertainment industries that are relatively high-wage industries in the economy (Table 4).

Table 4. U.S. Industries with the Highest Levels of Employment in Multimedia and Animation, 2005

Industry	Employment	Hourly Mean Wage	Annual Mean Wage
Motion Picture and Video Industry	5,640	\$34.50	\$71,750
Advertising and Related Services	4,950	\$25.51	\$53,050
Computer Systems Design and Related Services	3,050	\$29.03	\$60,380
Software Publishers	1,360	\$27.76	\$57,750
Radio and Television Broadcasting	1,080	\$21.87	\$45,490

Source: U.S. Department of Labor, Bureau Labor Statistics.

These top employers of Multimedia Artists and Animators have a strong presence in California and the Los Angeles region. According to the U.S. Census, California has more than 30 percent of the U.S. the motion picture

and video employment and establishments, 15 percent of U.S. employment in architectural services, and more than 25 percent of employment in software publishing.

Table 5. California's Share of U.S. Employment and Establishments in Top Multimedia and Animation Employer Industries

	California's Share of Total U.S. Employment	California's Share of Total U.S. Establishments
Motion Picture and Video Industries	33.5%	31.0%
Advertising and Related Services	13.3%	12.9%
Computer Systems Design and Related Services	14.2%	14.2%
Software Publishers	27.3%	19.9%
Radio and Television Broadcasting	12.5%	10.6%

Source: U.S. Census, County Business Patterns.

The concentration of entertainment, design, and technology companies in California and Los Angeles might explain why employment for Multimedia Artists and Animators is increasing in Los Angeles even though employment for this occupation appears to be declining nationally. Besides the top employer industries cited above, the Los Angeles region has a growing number of digital visual effects companies, video game publishers, visualization studios, and web-site developers that hire Multimedia Artists and Animators.¹³ Therefore, compared to the nation, Los Angeles may have a greater representation of multimedia and animation specialists that work with the latest technology tools and produce digital outputs. As a result, even if more traditional multimedia jobs declined overall, because of the concentration of new media

¹³ These businesses are not classified as separate industries under the NAICS system. Therefore, there is no employment data from government sources.

companies in Los Angeles, the region is in a better position to capture more of the employment growth than the rest of the nation.

The concentration of entertainment, design, and technology companies in California and Los Angeles may explain positive employment outlook for Multimedia Artists and Animators.

In fact, employment growth trends in art, design and entertainment related occupations in California are expected to continue over the next five to six years. According to employment projections published by the California Employment Development, art and design occupations are expected to grow by 21 percent between the years 2002 and 2012, significantly higher than 18.6 percent for all occupations in the state. EDD is also projecting Multimedia Artists and Animators to grow almost 28 percent over the same period. Other design occupations such as graphic designers and commercial and industrial designers will also grow 19 percent and 17 percent, respectively. See Appendix 2 for employment growth projections in art and design related occupations.

The overall growth projections for art and design related occupations in California, combined with the strong presence of creative industries in the region, indicate a positive employment outlook for Multimedia Artists and Animators.¹⁴

V. Multimedia Career Considerations

Anyone considering a career in multimedia will need to explore various trends and conditions that affect short and long-term employment, e.g., specialization, earnings, employment, education and training requirements. These and other considerations are summarized below.

¹⁴ Recent research on creative occupations and industries suggests that cities and regions with a high concentration of a creative workforce reap economic benefits that extend beyond the specific industries in which they are employed to the larger regional economy. Moreover, a concentration of a creative workforce in a city or region acts as a magnet for other creative workers and the industries that hire them.

- **Balancing Creativity and Employer Needs:** Most artists seeking to use their talent and creative skills to earn a living will find that in most work situations employers require them to balance creativity, innovation, and aesthetic expression on one hand, with the business needs of productivity, commerce, and efficiency on the other. Although the balance will vary depending on culture of the industry and work processes, it is important to understand the difference between art for art's sake and art for commercial purposes. Employers look for highly talented and creative professionals but they also demand that these individuals meet their business needs. Artists may be asked to adhere to predetermined set of design standards rather than express their own artistic style. In interviews, artists may be asked how their designs and artistic creations can be applied in ways that are relevant to the employer. Artists also need to work with non-artists and standard business documents created in standard word processing or spreadsheet applications.
- **Occupational Specialization:** There is a full spectrum of occupational specialization in multimedia. Some employers look for individuals with high level of specialization while others seek a generalist with a wide range of multimedia skills. Complex and large scale projects such as games or digital visual effects tend to rely on teams of professionals with highly specialized skills. Companies that want more flexibility in staffing may also hire specialized artists and technical specialists based on production needs and schedules. This type of flexible staffing arrangements results in the hiring of freelance artists and/or requiring employees to take on multiple projects. On the other hand, in situations where multimedia skills are not integral to the production process but are needed to develop a multimedia project for marketing purposes,

the employer may prefer to hire individuals who possess a wider set of skills. These individuals are expected to develop and implement a multimedia project from design to final editing.

- **Project-Based Employment:** Many multimedia professionals choose to work as freelance workers (independent contractors).¹⁵ For freelance workers, getting employment on a regular basis can be challenging and time consuming. They spend significant amounts of time looking for work and networking with other artists and potential employers. Unstable employment pattern also require workers to manage and plan their finances for the possibility of prolonged unemployment spell. On a positive note, artistic and technical workers are paid relatively high wages. The average annual wage for Multimedia Artists and Animators in the Los Angeles metropolitan division was \$80,870 in May 2005, almost double the average annual wages (\$41,420) for all occupations. Multimedia Artists and Animators earned more than computer programmers (\$71,100) and architects (\$70,061). Average annual wages in California were much higher than wages at the national level. See Appendix 3 for average annual wages in art and design related occupations.
- **Education and Training:** In multimedia, the need to keep up-to-date on the latest developments and changes in software applications, computer platforms, and digital techniques, is critical to creative and technical workers. Although most companies encourage and support some form of education and training, most artists and computer specialists acquire training on their own. This means they must devote time when they could be working or their

¹⁵ The study on new media industry by Batt et.al. suggests that the career path for new media workers is to go from employee to freelance worker and finally to entrepreneur.

New media workers spend on average seven hours of paid time and eight hours of unpaid time a week learning new skills on their own.

limited leisure time to training and learning. A recent study has shown that new media workers spend on average seven hours of paid time and eight hours of unpaid time a week learning new skills on their own.¹⁶ In contrast, on average, workers spent only about 1 hour a week on formal training. Technical training – learning a computer programming language, software applications, network administration – can be expensive. Non-technical training such as fundamental art skills, project management skills and business strategy might be less expensive and time sensitive than technical training; however, it is just as critical as technical training. Graphic artists face constant pressure to stay fresh in their ideas and design styles. This motivates artists to track new design trends and seek out projects that are more challenging and offer opportunities to expand and update their portfolios. Another important area of training is business and project management. However, artists and technical professionals face difficulty in obtaining training in business skills. For example, because business strategy and project management skills are generally taught by business schools, these courses are not easily accessible to working professionals.

VI. Multimedia and Animation Courses at the Community Colleges

The community colleges in the Los Angeles Community College District offer courses that are relevant to multimedia and animation occupations.

¹⁶ Batt, Rosemary, Susan Christopherson, Ned Rightor, Danielle Van Jaarsveld, (2001). *Networking: Work Patterns and Workforce Policies for the New Media Industry*. Economic Policy Institute: Washington D.C.

A survey of program and curriculum information identified 231 multimedia and animation related courses that are currently offered at the District's nine community college campuses.¹⁷ See Appendix 4 for a sample of course titles grouped by multimedia subject areas.

Table 6. Number of Multimedia and Animation Related Courses Offered at the LCCD Colleges, 2006

Subject Area	Number of Courses
Graphic Design	47
Art Fundamentals	36
Web Site Design/Programming	32
Computer Graphics	27
Digital Publishing	21
Multimedia	16
Photography	13
History and Theory	11
Animation	9
Post Production	7
Digital Video	6
Career Development	6
Total	231

As shown in Table 6 above, the courses offered cover the whole range of multimedia and animation skills. A close examination of course titles and descriptions revealed that the colleges offer a number of courses that focus on specific computer software packages that are currently used to generate multimedia and related content. These software programs include Photoshop, Director, Flash, 3D Studio Max, Maya, and Dreamweaver.

¹⁷ Information on multimedia and related courses were collected from web sites of the nine colleges in the District: Los Angeles City College, East Los Angeles College, Los Angeles Harbor College, Los Angeles Mission College, Pierce College, Los Angeles Southwest College, Los Angeles Trade-Technical College, West Los Angeles College, and Los Angeles Valley College. The information was not verified for accuracy or current status. Some of the courses may not be offered regularly.

Of the nine colleges, four of them (Los Angeles Mission College, Los Angeles Trade-Technical College, Los Angeles Valley College, and West Los Angeles College) have a multimedia/media arts program. Other colleges offer multimedia and animation courses through a number of different departments and programs, including art, computer science, computer applications and office technologies, visual communications, media arts, and computer science and information technology.

VII. Conclusion: The Role of Community Colleges

This study has closely examined multimedia occupations and skills to explore employment opportunities in the Los Angeles region. The core multimedia skills include graphic design, interface design, animation, video and audio production, and computer programming. These skills are applied in many different industries from aerospace to video games. Today, multimedia content is developed for computers, video consoles, interactive television, and the World Wide Web. On the production side, computer technologies are becoming more integral to multimedia. Therefore, multimedia is converging with the emerging new media sector. Multimedia Artists and Animators in Los Angeles can expect relatively strong growth in employment opportunities for the next 5 to 6 years. They also earn higher wages than workers in other occupations. The concentration of entertainment, design, and other creative industries as well as computer technology industries in the region will continue to promote growth in multimedia occupations. Those Multimedia Artists and Animators who work on short-term projects as independent contractors especially benefit from being part of a large network of creative and technical professionals in the Los Angeles area.

Continuing considerations for workforce development in multimedia include 1) keeping up with technology and how it affects core skills sets

and therefore education and training, 2) understanding employment and earnings implications of project-based staffing practices, and 3) documenting cross-industry mobility to better understand employment opportunities for current and future workforce.

The community colleges in the Los Angeles Community College District already play an important role in the development of multimedia workforce. Statewide and local workforce initiatives such as Multimedia & Entertainment Initiative (MEI) and CreateLA are building bridges between the community colleges and local businesses. However, there is a continuing challenge to build new relationships and maintain existing ones. Some employers already have relationships with the community colleges but others do not. There are also businesses that have relationships with educational organizations outside the state. Creative and innovative strategies are needed to promote opportunities for education-industry interface. Suggestions from employers include career and promotional events and direct outreach to businesses. The District should consider marketing the system as a whole to employers. Strategies include: advertising in industry related publications, exhibiting at industry trade shows, participating as panel members at industry conferences, or organizing conferences to which industry professionals are invited to speak or even better, teach. Innovative approaches, such as the LA Valley College IDEAS workshops that were developed in conjunction with an industry union, should be encouraged and supported throughout the District.

Multimedia curricula at the colleges is offered through a targeted comprehensive multimedia program or through various departments. The advantages of the second more flexible model include 1) greater flexibility in designing a course of study that fits individual needs, 2) access to greater depth of expertise and knowledge base from the departments offering the multimedia courses, 3) efficient management and distribution

of limited resources. The advantages of a more comprehensive multimedia program include 1) systematic and coherent interdisciplinary program, 2) one-stop training, 3) promotion of identity and culture that can be easily marketed to students, faculty and employers.

This study has shown that multimedia specialists spend lot of time updating their skills and learning new ones. The community colleges currently offer education and training in many of the core artistic, technical, and managerial skills. However, there are limited options in subject areas such as project management, business strategy, and career development. These are especially important subjects for freelance professionals and project managers. This might be another way of marketing to the industry by targeting specific industry associations (such as the Hollywood Post Alliance, the Broadcast Design Association, the Game Developers Association, the American Institute of Architects, the Visual Effects Society and even local chambers) whose members have employees moving up the ranks into supervisory roles. Perhaps industry professionals could be employed as adjunct instructors or professional experts to assist one or more colleges in developing an industry centered business curriculum.

Finally, multimedia is a dynamic field. To benefit current and future multimedia workforce in Los Angeles, it will be necessary to continuously monitor and track technological impact on skills and changes in employment trends.

APPENDICES

APPENDIX 1

COMMON MULTIMEDIA SOFTWARE TITLES AND DESCRIPTIONS

Title	Publisher	Description
3D Studio Max	Autodesk	Application for creating 3D graphics and animation. Key features include animation, modeling, UV mapping, skinning, scripting language, rendering, lighting, and visualization.
Combustion	Autodesk	Application for digital video artists. Tools include Timewarp which is used to create slow-motion and speed-up effects, edit operator, composite, paint, particle system and so on.
Discreet Flint	Autodesk	Application for creating motion graphics and interactive visual effects for broadcast and post-production projects. Key features are Layer-Based Paint, batch Text Node, Motion Estimation Timewarp, Expanded Clip History, Improved UI and Navigation, and Cleaner XL Integration.
Dreamweaver	Adobe	Used for web site design and management. Basic functions include formatting text and images using HTML (Hypertext Markup Language), adding links, tables, forms, and images, and incorporating dynamic time-based behavior and interaction using JavaScript.
Final Cut Pro	Apple	A program used to edit video formats from DV and SD to XDCAM HD, DVCPRO HD and uncompressed high-definition video. Key features include real-time multicamera editing tools for DV, SD and HD. This feature allows editors to simultaneously play back and view shots from multiple sources and cut between them in real time.
Fire	Autodesk	Nonlinear editing and finishing application for high resolution film, digital cinema, and high-definition post-production projects. Key features are 64bit architecture, clip history, gap effect, soft text, cleaner XL integration, overlay user interface, keycode, VTR emulation, burn for the timeline.

APPENDIX 1
COMMON MULTIMEDIA SOFTWARE TITLES AND DESCRIPTIONS
(Continued)

Title	Publisher	Description
Flame	Autodesk	Compositing tool for post-production projects. Application allows for seamless integration of resolution-independent live-action layers and 3D elements in an interactive 3D environment. Other tools include advanced keying and rotoscoping, integrated paint and text, color correcting and grading, and Autodesk Burn background renderer.
Houdini Escape	SideFX	Application for Computer Generated feature films and television series. It is used for rigging and animating characters and for lighting. Animated characters can be rendered in Houdini Mantra or, with the Renderplus add-on, by many popular 3 rd party renderers.
Illustrator	Adobe	Used to produce vector graphics (images described in mathematical terms in contrast to bitmapped images) that can be edited and transformed. Primary functions are drawing technical diagrams and illustrations. It is also used to fill in shapes with complex color gradients and produce an appearance of drawing done with traditional materials such as charcoal, watercolor, and ink.
Lightwave	New Tek	Application for creating 3D animation and graphics in print, movies, television, games, and architectural visualization.

APPENDIX 1
COMMON MULTIMEDIA SOFTWARE TITLES AND DESCRIPTIONS
(Continued)

Title	Publisher	Description
Lustre	Autodesk	Application for working with high-resolution imagery and digital intermediates and allows for real-time primary and secondary color correction and grading. Features include real-time primary color grading of 10- and 16-bit 2k scans, real-time selective (secondary) color correction tools (requires incinerator), resolution independence, printer light color timing mode (calibratable to lab process), unlimited vector shapes, keying, and tracking in selective, advanced gmask vector shape tools for non-uniform light and color fall-off, integrated motion tracking, and visual timeline—conform and editing capabilities.
Maya	Autodesk	Application for character animation, modeling environments that incorporate sophisticated texture maps, optimizing scenes without loss of detail, realizing the 2D Toon look of comic books, cartoons, manga and anime, creating clothing, fur or long hair for characters, managing multiple render passes from within a single scene and produce compositor-ready render layers. Application is capable of moving data quickly back and forth between Maya and Adobe Photoshop®, or Adobe Illustrator® and importing high-performance CAD data.
Motion 2	Apple	This animation program has built-in filters, a particle generator, and title animations. A particle generator, for example, is used to design real-world effects such as smoke, sparkles or fire. Motion 2 allows for play back in multiple streams of video, filters, text and particles, and moving or resizing video layers on the fly.
Photoshop	Adobe	Application for editing, processing and managing digital images. Tools include Vantage Point which allows users to clone, paint, and paste elements that automatically match the perspective of the surrounding image area.
Premiere	Adobe	Used to capture video, edit video and sound, apply effects and transitions in real-time, and export completed clip different formats (e.g., digital for CD-ROM or web distribution).

APPENDIX 1
COMMON MULTIMEDIA SOFTWARE TITLES AND DESCRIPTIONS
(Continued)

Title	Publisher	Description
Renderman	Pixar	Rendering application developed by Pixar is stable, fast, and efficient for handling complex surface appearances and images. RenderMan's shading language and anti-aliased motion blur allow designers to believably integrate synthetic effects with live-action footage.
Soundtrack Pro	Apple	An audio and sound design application. Soundtrack Pro allows users to record, modify, suspend, or delete any audio edit or process — or easily identify and repair common audio problems such as background noise, clicks, pops, and hum. It also include sound mixing capabilities that allows for creation of innovative sound effects.
TestTrack	Seapine	Application for tracking projects and managing team collaboration. Program includes advanced security features and customization.
Zbrush	Pixologic, Inc.	A graphic application aimed at simplifying the science behind generating computer graphics. ZBrush appeals to a wide audience by providing empowering tools that give users intuitive and visual control over the digital images they create. By providing a synthesis of 2D and 3D capabilities in a single stand-alone tool, ZBrush collapses economic and ease-of-use barriers to creating images.

Source: Chapan, Nigel and Jenny Chapman (2003). *Digital Media Tools*. 2nd Edition. John Wiley & Sons: West Sussex, UK. Various software publisher and new media company web sites.

APPENDIX 2

EMPLOYMENT PROJECTIONS FOR ART AND DESIGN RELATED OCCUPATIONS, CALIFORNIA

SOC Code	Occupational Titles	Yr 2002	Yr 2016	Numerical Change	Percent Change
27-1022	Fashion Designers	2,300	3,000	700	30.4%
27-1027	Set and Exhibit Designers	1,000	1,300	300	30.0%
27-4032	Film and Video Editors	4,000	5,200	1,200	30.0%
27-1014	Multi-Media Artists and Animators	7,900	10,100	2,200	27.8%
27-4014	Sound Engineering Technicians	3,000	3,800	800	26.7%
27-2012	Producers and Directors	11,400	14,300	2,900	25.4%
17-1011	Architects, Except Landscape and Naval	11,100	13,800	2,700	24.3%
27-2032	Choreographers	2,100	2,600	500	23.8%
27-1099	Art and Design Workers, All Other	3,400	4,200	800	23.5%
27-1025	Interior Designers	5,200	6,400	1,200	23.1%
27-2042	Musicians and Singers	13,600	16,300	2,700	19.9%
27-1024	Graphic Designers	21,200	25,300	4,100	19.3%
27-1023	Floral Designers	5,200	6,200	1,000	19.2%
27-4031	Camera Operators, Television, Video, and Motion Picture	4,400	5,200	800	18.2%
27-2041	Music Directors and Composers	3,400	4,000	600	17.6%
27-1021	Commercial and Industrial Designers	2,900	3,400	500	17.2%
27-2011	Actors	39,000	45,600	6,600	16.9%
27-3043	Writers and Authors	6,800	7,900	1,100	16.2%
27-2031	Dancers	2,600	3,000	400	15.4%
27-1011	Art Directors	2,800	3,200	400	14.3%
15 -021	Computer Programmer	48,200	53,700	5,500	11.4%
27-4021	Photographers	6,900	7,300	400	5.8%

Source: California Employment Development Department. Labor Market Information Division.

APPENDIX 3

AVERAGE ANNUAL WAGES FOR ART AND DESIGN RELATED OCCUPATIONS, MAY 2005

		Los Angles – Long Beach – Glendale*	United States
	All Occupations	\$41,420	\$37,870
15-1021	Computer Programmers	\$71,100	\$67,400
17-1011	Architects, Except Landscape and Naval	\$70,760	\$68,560
27-1011	Art Directors	\$90,070	\$73,790
27-1014	Multi-Media Artists and Animators	\$80,870	\$57,270
27-1021	Commercial and Industrial Designers	\$53,970	\$56,780
27-1022	Fashion Designers	\$67,150	\$67,370
27-1023	Floral Designers	\$26,170	\$22,410
27-1024	Graphic Designers	\$47,020	\$42,530
27-1025	Interior Designers	\$49,290	\$47,010
27-1027	Set and Exhibit Designers	\$53,440	\$41,920
27-2012	Producers and Directors	\$98,640	\$68,970
27-3043	Writers and Authors	\$88,540	\$53,850
27-4014	Sound Engineering Technicians	\$61,110	\$47,790
27-4021	Photographers	\$37,740	\$31,410
27-4031	Camera Operators, Television, Video, and Motion Picture	\$69,400	\$46,040
27-4032	Film and Video Editors	\$63,790	\$54,730

Source: U.S. Department of Labor, Bureau of Labor Statistics. *Los Angeles-Long Beach-Glendale, CA Metropolitan Division. These wage estimates are based on data was collected from employers from all industry sectors. Data excludes freelance (independent contractors).

APPENIX 4
LACCD MULTIMEDIA AND ANIMATION CURRICULUM:
COURSE TITLES*

Multimedia and Animation Subject Areas	Course Titles*
Art Fundamentals	Color Theory Drawing Perspective Drawing Illustration for the Graphic Artist Scale Drawing Techniques
History, Theory	Art Appreciation Art Production Methods Color Theory Design in Nature History of Contemporary Art Introduction to Entertainment Industry Crafts Visual analysis, introduction to semiotics, brief art history survey
Animation	Three Dimensional Animation Animation Process and Production Character Development and Drawing for Cartoons and Animation Computer Applications For 3-D Animation: Lightwave 3D, Maya Interactive Animation. Experimental Animation: Claymation, Puppets, Cel Animation, Animation Theory Storyboards Web Animation: Macromedia Flash And Director
Graphic Design	2D Design Fundamentals Advanced Graphic Design Advertising Concepts Beginning Three-Dimensional Design Graphic Communications Introduction to Digital Imaging Introduction to Graphic Design and Drawing Concepts Presentation Graphics

*Some titles have been modified. For example, sequence numbers have been eliminated. Beginning and advanced courses are also offered for some titles.

APPENIX 4

**LACCD MULTIMEDIA AND ANIMATION CURRICULUM:
COURSE TITLES* (continued)**

Multimedia and Animation Subject Areas	Course Titles
Computer Graphics	Basic Computer Systems Advanced Graphic Design for the World Wide Web Computer Application Mediarts 3D Computer Graphics Computer Illustration Digital Drawing Digital Image / Motion Graphics Digital Imaging: Advanced Photoshop and digital photography
Multimedia	Communication via Multimedia Interactive Multimedia: Macromedia Flash and Director Design For 3-D Computer Applications: 3D Studio Max Game Design: Creating Custom Games in Director and Flash Multimedia Presentations and Internet Basics Multimedia Presentations Using Powerpoint Illustration For Multimedia Introduction To Adobe Photoshop For The Office Vector Graphics: Adobe Illustrator
Photography	Advanced Laboratory Procedures Advertising Photo/Graphics II Creative Photo-Vision Digital Photo Manipulation Intermediate Black and White Intermediate Computerized Digital Photography
Post-Production	Digital Editing with Final Cut Pro; Titling and Effects Digital Editing: Adobe Premiere Digital Film/Video Editing

APPENIX 4
LACCD MULTIMEDIA AND ANIMATION CURRICULUM:
COURSE TITLES* (continued)

Multimedia and Animation Subject Areas	Course Titles
Digital Video & Audio	Digital Film/Video Cinematography D V Production: Footage Acquisition Digital Audio Basics Digital Video Basics
Digital Publication	Desktop Publishing Design Computerized Composition Desktop Publishing Applications Digital Page Layout Digital Typesetting Practical Editing Typography
Web Site Design / Programming	Introduction to Web Site Design Web Design: HTML, Adobe ImageReady, Macromedia Dreamweaver, & Flash Web Page Authoring Fundamentals Visual Basic Programming Hyper-Text Markup Language (HTML) Advanced Programming with JAVA Server-Side Programming for the World Wide Web
Career Development	Digital Portfolio Preparation Graphic Design Business Practices

*Some titles have been modified. For example, sequence numbers have been eliminated. Beginning and advanced courses are also offered for some titles.

APPENDIX 5
INTERVIEW PARTICIPANTS

We are grateful to the following individuals for their expertise and valuable comments.

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APPENDIX 6

REFERENCES: PUBLICATIONS AND WEB SITES

Publications

Batt, Rosemary, Susan Christopherson, Ned Rightor, Danielle Van Jaarsveld, (2001). *Networking: Work Patterns and Workforce Policies for the New Media Industry*. Economic Policy Institute: Washington D.C.

Chapman Nigel and Jenny Chapman (2003). *Digital Media Tools*. 2nd Edition. John Wiley & Sons: West Sussex, UK.

England, Elaine and Andy Finney (2002). *Managing Multimedia: Project Management for Web and Convergent Media*. Book 1. People and Processes. Addison Wesley: London, UK.

Entertainment Industry Trend Report: Labor Market Analysis (June 2004). The PMR Group, Inc. and Entertainment Industry Development Corporation. Los Angeles, CA.

Lee, Kathleen and Kathleen Milnes (2005). *Crossworking: High-Tech High-Tech Motion Picture and Television Workers in California - Exploring Employment Patterns and Industry Cross-Over Opportunities*. Entertainment Economy Institute. Los Angeles, CA.

Multimedia, the Complete Guide. (1996) DK Publishing: New York.

Vaughan, Tay (2001). *Multimedia: Making it Work*. Fifth Edition. Osborne/McGraw-Hill: New York.

Web Sites

America's Career InfoNet. Provides comprehensive labor market information for SOC occupations. National and state breakdowns are available. www.acinet.org.

Animation Industry Database. Provides directories and online search tool that cover animation, visual effects, and game development companies worldwide. www.aidb.com

Association for Computing Machinery, Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH). www.siggraph.org

Association for Computing Machinery Special Interest Group on Multimedia (SIGMM). www.sigmm.org

CG Architects. www.CGarchitect.com

Creativeheads: Jobs for the Right Brains. Official job bulletin for SIGGRAPH. www.creativeheads.net

O-Net Online. Occupational information. <http://online.onetcenter.org/>

Labor Market Information. California Employment Development Department. www.labormarketinfo.edd.ca.gov

APPENDIX 7

Contact Information

The Los Angeles Community College District

Workforce Development Program

CREATE LA:

CREATE LA is a Los Angeles Community College District Workforce Development program that provides support to the many Entertainment Studies programs offered throughout our nine colleges. The diverse entertainment programs that CREATE LA supports encompass all general and most specialized areas of the Entertainment Industry including Cinema, Television, Video, Broadcasting, Music, Theatre, Animation (Traditional and Digital) and Multimedia, as well as Production, Performance, Editing, Lighting, Costuming, Stage Management and Stage Craft. Students who successfully complete LACCD's programs can earn an Associate of Arts degree, a Certificate (in a Specialization), or use earned credits for transfer to a four-year school.

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http://www.laccd.edu/workforce_dev/create-la/

The Entertainment Economy Institute

The mission of the Entertainment Economy Institute is to accurately document the impact of the entertainment industry on the economy and to respond to the current and future workforce needs of all segments of the entertainment industry. It accomplishes this through three principal activities: economic and occupational research; access to training for current industry professional and outreach to educational institutions and community-based organizations. The Entertainment Economy Institute is a project of Community Partners, a 501c(3) organization

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