DESIGNING EFFICIENCY: THE BENEFITS OF PREVISUALISATION IN FILM AND ANIMATION TEACHING PROGRAMS

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Abstract

The content of this paper demonstrates how film, screen and 3D animation educators can derive great benefit from incorporating 3D pre-visualisation (previs) content in their program structure. Educators have an obligation to provide students with high-quality, industry-current skills and knowledge. To do this, they must regularly assess the effectiveness of their teaching methods, course content and teaching resources and respond by revising these areas as necessary. It is this obligation to identify ways of improving course content that motivated the topic of this paper.

The evidence presented in this paper is gathered from the author's teaching, research and production experiences in 3D animation and pre-viz. For example, events in the classroom revealed that 3D animation students who used previs to block out the animation of their short animated film projects could utilise the previs at various other points along the production pipeline. As a consequence, it was seen that students completing live-action film and television projects could make use of previs in a similar fashion. In fact it quickly became apparent that previs could contribute to nearly every single area of students' animation and live-action film production processes. It also became conceivable that mutually-beneficial collaborations between film and animation students - especially those concentrating on directorial roles - could be forged, where animation students could create 3D previs for film student projects and then benefit from exposure to the live action film directing process.

The conclusions to be drawn from these findings are that by taking advantage of the central role that previs plays in film and 3D animation production, educators can provide students with a highly sought-after skill, enable mutually-beneficial collaborations between student filmmakers and maximise productivity in students' creative output.

Keywords - 3D animation, previsualisation, film education.

1 DESCRIPTION OF THE PROJECT

1.1 Definition of terms

3D: refers to the digital images and files generated from 3D graphical software programs such as Autodesk Maya and 3DsMax. It does not refer to stereoscopic 3D imagery in this case.

CGI: Computer Generated Imagery, which refers to images output from various computer graphics software programs.

Film school: The term 'film school' is used as a blanket term to describe any educational institution that provides training in film and screen media, animation, and/or interactive games design.

Previs/Previz: abbreviation of the term previsualisation. Previs is a virtual representation of a shot, usually performed in 3D software, as a moving image. It is not to be confused with architectural previsualisation.

VFX: Digital Visual Effects, generated at the post production phase to supply visual effects (explosions, fire, smoke for example) to a film.

Motion capture/mocap: the recording of actions performed by human actors, via special technology such as a motion capture suit, which is then transposed to a digital 3D character model.

Storyboard: small sketches of each shot in a film, assembled into a series of panels in the order that the shots appear.

Animatic: a rough edit of a film, often constructed from scans of the storyboard panels.

1.2 Disciplinary context

This paper posits that previsualisation (previs) represents an increasingly important filmmaking technique that should receive more emphasis and status in film school curriculums. Schools can implement previs content in their programmes relatively easily, and both they and their students can reap many benefits from doing so. This paper explains what these benefits are, and explores some practical ideas as to how previs can be included in film school courses. Hopefully the information presented here will be helpful to those educators who are involved in training the filmmakers of the future.

1.3 Project background

My interest in this topic arises from my previous occupation as a previs artist and visual effects coordinator in film and television production, from my previous studies in 3D animation, and from my current position as a lecturer at the Griffith University Film School in Brisbane, Australia. The Griffith Film School provides undergraduate and post-graduate programmes in film, animation and games design and is currently the largest film school in Australia. It would be fairly safe to assume that many other film schools around the world share similar objectives to those held by the Griffith film school – the delivery of up-to-date course content that serves the needs of the film, games and animation industries. Previs is fast becoming a key component of the film and animation production process, and therefore represents a crucial skill area to include in a film school curriculum [1]. This project also addresses another pressing requirement – locating a way to assist students to complete their film and animation projects more effectively. As this paper will reveal, previs can answer this need.

2 DEFINITION AND HISTORY OF PREVIS

2.1 What is previsualisation?

Previs is a virtual representation of a shot, usually performed in 3D software, as a moving image. It could be described as being the blueprint of a film. The Previsualization Society provides the following definition:

> Previs is a collaborative process that generates preliminary versions of shots or sequences, predominantly using 3D animation tools and a virtual environment. It enables filmmakers to visually explore creative ideas, plan technical solutions, and communicate a shared vision for efficient production [2].

2.2 A brief history of previsualisation

Previs has existed for many years in one form or another, as directors have utilised whatever tools have been available that allowed them to experiment with ideas and communicate a creative vision to others. Foam-core cut-outs, video, paper dolls and action figures are among the many inventive techniques used . It wasn't until the early 1990s that 3D digital previs started to be utilised, although its scope was fairly limited, given that the software used to create it was fairly rudimentary [3]. Over the past twenty years or so, as 3D software has become more accessible and more sophisticated, so has the previs that these programs generate. As a consequence, the use of previs in production has become more prevalent, and the skills required to create it have become more complex and multifarious. Previs is now at a point in its evolution where its creation is primarily in the hands of specialist previs artists working under the instruction and guidance of a director. The previs that results from this artistic collaboration is a virtual 3D representation of the director's intentions of individual shots in a film. In this form previs provides a highly effective method of communicating the director's ideas to others on the production team.

There are numerous software programs that can be utilised to generate previs but probably the most commonly-used software for the job are 3D graphics programs such as Softimage XSI, Autodesk Maya or 3DSMax. There are a number of advantages in using these programs. One is that the previs files themselves can often be utilised at later stages of the pipeline. For example, they can be supplied to the animators or Visual Effects (VFX) artists to use as foundation files for their work, which obviates the need to start their VFX work from scratch. Another extremely useful aspect of using 3D programs for previs is that they have the ability to create a virtual space that can exactly represent the intended live action film set or (for animated productions) animation environment. This space can be easily populated with cameras and characters that can be animated to indicate the camera movement and action that is to take place in the shot [4].

2.3 Real-time previsualisation and motion capture

Another very promising option for generating previs lies in utilising motion-capture and game engine technology to generate real-time previs. Like the aforementioned 3D software methods, real-time previs can recreate an environment, characters, camera and lighting but it can be generated very quickly and intuitively via games controllers, such as a joy stick, to move characters and cameras in 3D space. This means that directors can participate more easily in the previs construction process. So, rather than having to verbally or otherwise instruct a previs artist to create the previs for them, directors can take the controls, explore the space, try different framings and camera movements and generate previs at the same time. Actors hooked up via a motion capture suit can generate animation that is immediately transferred to 3D characters in the previs environment [5]. This technique is still in its infancy, and there are challenges involved with using it. For example the previs files are not always portable to other areas of the pipeline, but in some instances the advantages outweigh the disadvantages [6].

2.4 The mechanics of previsualisation

Previs shots can contain the following elements:

- Sets and props – scale-accurate representations of the intended film's production environment
- Characters - low-detail computer-modelled versions of the actors, which can be animated roughly to indicate the action to take place in a shot.
- Cameras - virtual representations of live-action cameras which can therefore replicate real cameras' behaviour and movement.

Characters, sets, and props are usually modelled to a fairly low level of detail so that they can be manipulated quickly and easily in the computer software. These are later replaced with high-detail models for shots that are going to be digitally created — for example in an animation production pipeline where shots are entirely digitally generated or in live action shots that require some VFX content [7]. Figure 1 below provides an example of a typical previs shot, prepared in this case for an animation production. The characters are positioned in the environment and roughly animated to indicate where they will be situated throughout the shot and the general action that will take place. Lighting may or may not be included – in this example it is not included. The camera is positioned and its movements animated. The shot is then rendered out as a short clip that may be imported into the production edit. The director then reviews the shot and instructs the previs artist to make revisions as necessary until the shot is approved. The approved previs shot file then forms the basis of the final animation or VFX work to follow and is also utilised or otherwise referred to by the rest of the production team to inform their individual contributions to the production pipeline. For example, the previs can provide information about set design and construction, acting notes, editorial information, notes for the Director of Photography (DOP) etc. Finally, once the animation is completed, the finishing touches such as VFX and lighting are added to the shot, which is then rendered and sent to the editorial department for inclusion in the final edit.

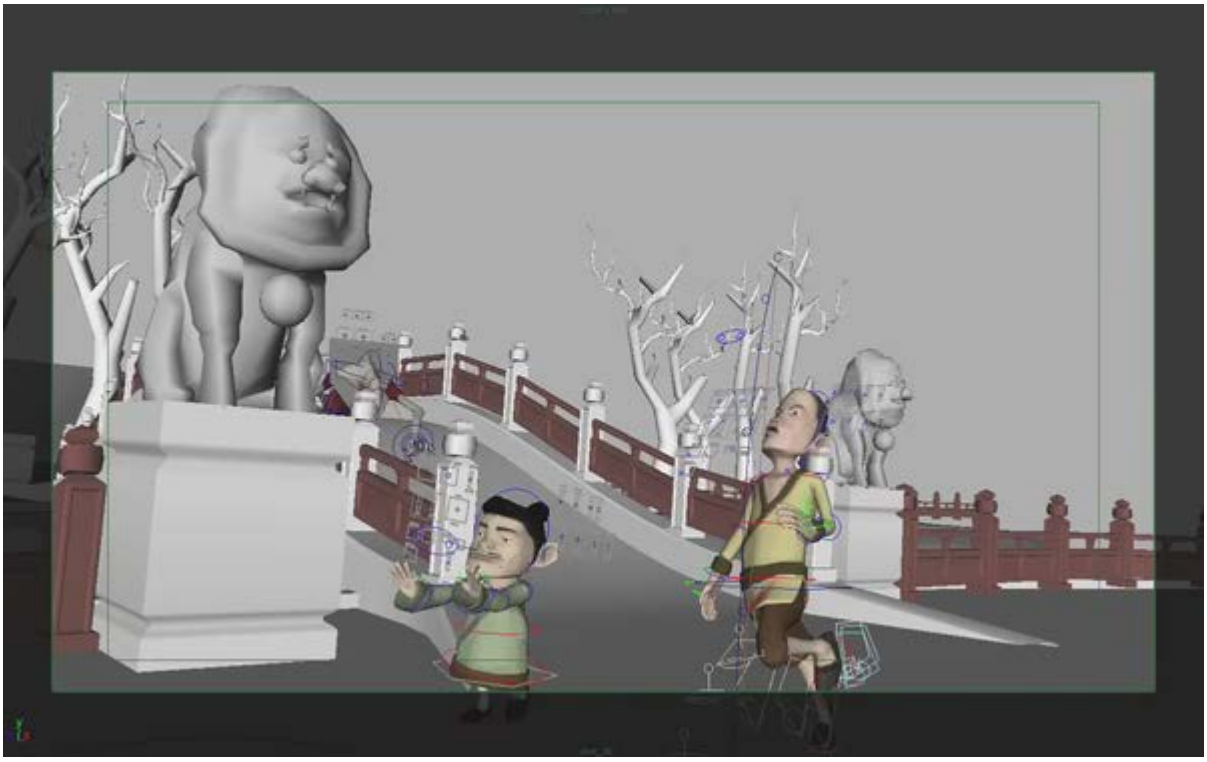

Fig.1 above is a previs shot from a student animation project, showing low-detail modeled environment and characters, framed through a virtual camera.

In summary, previs allows the director to plan, test, revise and finalise shots before shooting or animating. Sometimes previs is constructed before production has been approved, used in that case as a proof-of-concept to pitch for funding or to obtain the green light on a proposed project. The important role that previs plays in a film or animation production environment is clear. Its value in a film school programme will be discussed in the following section.

2.5 The importance of previsualisation in film school programmes

Previs is now widely used in the film and animation industry and its usage is increasing exponentially. Thomas Mclean of Animation World Magazine states that 'a relatively new tool for filmmakers, previs has become a common practice for working out complicated shots and the integration of visual effects on movies of all types' [8]. This increased usage of previs has resulted in the establishment of a number of specialty previs facilities (most notably in the United States) and the expansion of previs departments in VFX production houses [9].

Australia is yet to see any significant growth in specialist previs facilities. In most cases previs is created in-house at VFX studios [1]. Locating skilled previs artists to fill positions at these facilities can be challenging. Ideally these artists should possess a number of key skills, including staging and blocking skills [1], 3D character animation, cinematography, and the ability to communicate effectively [10]. Not all candidates have the necessary skills or experience, and indeed most recruits have never received any form of previs training at a college or other educational institution. Instead they have had to learn on the job [1]. I can attest to this from my own personal experience of hiring previs artists for an animated television production which I worked on in 2007. The production company advertised widely for recruits, both in Australia and overseas. It took several months to locate enough artists (approximately twelve in total) to reach a full crew. These artists came from a wide variety of film and animation backgrounds, with varying levels of skill and expertise. Some were of junior status, possessing a reasonable amount of 3D knowledge which they had acquired from college or various courses or from previous employment, but these recruits had little or no previs experience. Others had previous work experience in previs, mostly in live action feature films, but again possessed no formal previs education or training. Interestingly, retaining the more junior recruits proved to be a challenge, as some appeared to view previs as a rather low-profile production job, definitely not as "cool" as more recognised roles such as animating or modelling. It seemed that they viewed previs as a stepping stone to something else rather than an important role in its own right. It is uncertain where this viewpoint comes from, but it is one that is acknowledged by the Previsualization Society, who,

among other things, are endeavouring to raise the profile of previs and to promote previs generally [11]. However it is encouraging to hear that in Australia at least, previs artist positions are now becoming more sought-after [1].

In order to maintain this kind of positive momentum, the Previsualization Society have initiated a number of developments designed to support and advance the previs community. They are inviting educators to assist them in their efforts [11]. Film schools are in a position to contribute their expertise by providing a suitable education for those students wishing to enter the previs industry. As we shall see in the next section, introducing previs into a film school programme can provide some additional benefits, helping to solve some particular problems that film and animation students may encounter as they complete their projects.

3 TROUBLESHOOTING STUDENT PRODUCTION PROBLEMS

One of my roles at the Griffith Film School is to oversee the production of the final-year bachelor of animation students' short film projects. While performing this role, I noticed some recurring problems with the quality and volume of the students' work. On further investigation it seemed that many of the students were struggling to understand some of the primary cinematic and technical concepts underlying their work. Specifically there were problems with continuity, pacing, timing and shot construction generally. They were experiencing difficulties in conveying directorial information to other team members, and finally, they were finding it very difficult to complete their projects on time. I imagine that these types of issues are not exclusive to our school.

In response to these problems, and in recognition of how previs makes production more efficient in commercial film and animation production, I decided to introduce previs to these students on a relatively informal basis and within the existing course structure, to see if this improved the situation.

3.1 How previsualisation was implemented into the student production pipeline

The animation students' existing workflow basically involved working from a script, to a storyboard, to an animatic, to the final animation, and then to a final edit. The addition of previs did not radically change this workflow — it was simply inserted between the animatic and final animation stages. This is where it would typically be situated in a commercial animation production for television or film. The students used Autodesk Maya to animate, so it made sense to create the previs in Maya so that the files generated from the previs would then flow through the production pipeline to form the basis of their final animation files. This was a very efficient use of resources and a process which also mirrored commercial previs production scenarios. The previs image files that were generated were added to their in-progress film edit, where decisions about shot length, framing etc. were made and the previs revised accordingly. Once all the previs revisions were made the animation could commence. This process mirrored that of a commercial production, where the director guides the construction of previs shots, reviews them and requests revisions until they are approved.

Fig.2. From left to right, these images show the progression from the storyboard stage, to previs and to final animation.

3.2 Results of the implementation

Overall, the introduction of previs to the animation students' production workflow proved to be a positive experience for students and staff, with many benefits gained. In particular, the animation students found that much time was saved because the previs allowed them to identify any number of errors or potential problems in their shots. This was important because it meant that these problems

could be rectified before the animation commenced. Fixing shot problems at the animation stage is very inefficient because of the length of time it takes to animate a shot. Re-doing animation to rectify a continuity issue, or throwing away completed animation because it is later determined that a shot is too long is a very inefficient use of time. To put this into perspective, it may take an animator a number of days to complete a first pass of animation on a shot. It may take a previs artist less than an hour to set up a previs shot and even less to revise it if required.

Here is a list of the benefits that were identified:

- Problems in pacing, timing, and continuity were identified and rectified at the previs stage. For example a character's pose at the end of one shot must match its pose at the start of the following shot. This is referred to as a "match cut". By assembling rendered previs shots in the film edit, the team could see where poses were not matching between shots.
- Problems with camera position and framing were identified and revised. For example if a shot broke the "180-degree rule" (where the camera crosses to the opposite side of an agreed stage line between shots) the previs would reveal this and the camera position would be revised to conform to this rule.
- The need for additional props and assets were identified before critical stages of production were reached. For example, perhaps during the construction of the previs it was discovered that in a particular series of shots a character needed to be carrying a basket, but the need for a basket had been overlooked when the list of props required for the film was prepared and so no basket had been modelled. A stand-in "proxy" basket (which would take only a few minutes to make) would be used as a placeholder in the previs until a fully-modelled and textured basket was built. This would ideally be ready by the time the animator started these particular shots.
- Modelling and rigging issues were identified and rectified before the animation commenced. The previs provided an effective testing ground for the 3D models and character "rigs" (internal skeletons that articulate character models) that were to be used in the animation phase. For example, perhaps during the positioning and posing of a character in a previs shot it was noticed that a character's feet were not rotating correctly. This could be fixed before the animator required the rig and therefore time was saved.
- Judgements as to the effectiveness of a planned camera angle or movement were made easier by viewing the previs of a shot rather than viewing a storyboard sketch or an animatic. Students found it very difficult to articulate or illustrate camera movements on paper. Storyboards provide a good starting point while sketching out ideas for camera moves, but to actually test it out and determine if and how it will work were much more effectively performed in the 3D space that previs provides.
- Students reported that viewing previs rather than a storyboard or an animatic gave them a better 'feel' for where the film was working and where it wasn't, allowing them to make more informed creative and editorial decisions as they shaped it into its final form.
- Previs was a highly efficient means to communicate creative ideas between team-members. Specific instructions as to how a shot was to be constructed or treated or animated were more effectively communicated via previs than from storyboards or animatics.
- Animators found it easier and faster to animate a shot that had been prepared and tested in previs. The characters' positions and poses were already set up for the animators and they did not have to waste time chasing up the models and props that they required - this had all been dealt with at the previs stage. Having the camera set up and animated in the previs was also a huge time-saver for them.
- Previs provided a means to experiment and test out creative ideas.
- All films were finished on time and generally to a higher level of quality than had been achieved previously.
- It allowed students to engage in a workflow that simulated industry practices as much as possible.

- Students learned to recognise the importance of adhering to technical requirements such as file naming conventions in the production workflow. Previs artists encounter these kinds of requirements in industry environments, where it is usual for technical staff to institute policies regarding file naming and storage so that tasks can be automated via in-house software tools.
- Lecturers found that giving students feedback on their films via the previs shots that they prepared was easier and more fruitful than was possible via animatics and storyboards. Lecturers also found it easier to interpret students' intentions for a shot by viewing the previs. It was also easier for lecturers to communicate revisions that needed to be made to a shot because they could open the 3D previs file and interactively demonstrate how shots could be better framed or characters placed etc. Students were therefore better able to understand and apply the feedback that was given to them.

3.3 Considerations for wider implementation of previsualisation across the film school's programmes

Implementing the previs into the animation programme was a learning experience for both students and staff. Some of the more important findings, which will inform a wider implementation of previs across the entire film school curriculum were:

- The length of time required to teach students the fundamentals of what previs is and how to construct it:

  The students in this case were all familiar with the 3D software (Autodesk Maya) that was used to generate the previs. They had also previously received training in shot construction and basic principles of cinematography in another subject which was included in their programme. This meant that they needed a relatively short amount of time (1 x 4-hour class) to learn and practice the primary previs concepts before they were able to proceed with constructing previs for their group film projects. This 4-hour class included tuition in some of the more technical aspects of previs - referencing concepts (i.e. linking 3D assets to a scene file rather than embedding it), file management, naming conventions, to name a few. It was found that some additional time needed to be allocated for lecturers to spend with individual groups to trouble-shoot problems specific to that group. Finally, approximately two hours was spent teaching and practicing the finer points of camera animation for previs, which was incorporated into one of a series of 3D-animation workshops that were already included in their course.

- The identification of necessary resources and technical infrastructure to support the previs work:

  Probably the most problematic aspect of the previs process for students was related to file sharing and file management. The computer lab facilities that the students were using did not provide them with a central server that they could use to store and share their files. The only file storage space that they had available to them was their own portable hard drives and the local drives on the lab's computers. This resulted in a number of problems. For example, the directory paths to referenced files in each previs scene were not consistently the same paths. That meant that the students needed to work around the software's default absolute file path system and change paths to relative. Some students struggled with this, because they were not familiar with these concepts and because, inexplicably, the software would apparently revert to using absolute paths from time to time and the student would need to override these back to relative paths again. Another problem they encountered was related to user permissions. The user permissions in the lab were set up so that users were not able to modify a file created by another user. This created a messy situation where students were not able to save their edits over the previous version of the file. This destroyed the ability for their references to refresh properly when previs scenes were opened. File sharing across the network was also next to impossible because of a university policy that was meant to prevent illegal file sharing. This meant that students could copy files from one computer to another across the lab network, but could not write to another computer. All of these problems combined meant that it was difficult for students to ensure that they were always working with the most recent files. It also meant that they were not following industry practices either. All of their work took longer because they were performing additional tasks to enable them to work around all of these limitations. In short, the sheer enormity of all the difficulties that the existing

system imposed led to the purchase of a dedicated server and the instituting of appropriate changes to the lab file-sharing and permissions arrangements.

- One student in the group should take on the role of production director:

  Groups that appointed one person to act in the role of director found it easier to maintain consistency in the overall production design than groups which attempted to incorporate direction from all of their team members. On the whole, this one-person directorial system was also a very democratic one, as long as all team members agreed on the specific style and vison for their project beforehand, and had decided upon the specific tasks that each member was to be responsible for. All team members would be present for regular 'dailies' sessions with their lecturer who provided additional directorial guidance. The latest previs shots were reviewed during these sessions and feedback given to the team.

3.4 The next stage of implementation

The findings that we have obtained from this initial exercise of introducing previs into our animation course has provided us with helpful data that will inform future strategies to implement previs more widely across the entire film school programme. Further investigation is required however, to ensure that we develop a strategy that provides for the unique previs requirements specific to each of the animation, film and games areas. The ASC-ADG-VES Joint Technology Subcommittee on Previsualization have identified five different categories of previs to cater for the diverse needs of different production environments [12]. Animated projects for example have different previs requirements to live action projects. Animators use previs to plan shots and to form the basis of their animation. Live action students use it to plan shots and to communicate instructions to other team members, such as set builders, production designers, actors and so on. Games students have their own particular previs requirements, and there is also the potential for them to contribute to the development of real-time previs systems that could be utilised by all of the film school students. All of this diversity makes it difficult to pin down the exact skills and knowledge which need to be transferred to students. Consultation with industry experts is one way of identifying key skill areas, and we will certainly be doing that, but perhaps another way is to set up a collaborative project between a select group of games, animation and film students and allow the project itself to reveal some answers. For example, the project could reveal information on the following:

- the resources (software, equipment etc.) that are required to complete the previs
- the previs expertise and skills that students from each area can contribute to the project
- the previs expertise and skills that students require from other areas
- the specific outcomes each group requires from the previs to satisfy their particular needs

A project like this also has the added benefit of providing students with a broad understanding of how their work fits in to other areas' production environments, supplying them with a wider perspective of what forms previs can take and how it can be utilised in a variety of circumstances.

The project could be mutually beneficial in its collaborative nature. For example the animation students could contribute their expertise in the use of the 3D previs software in constructing the previs under the guidance of a film school student who undertakes the role of director. This would mirror the typical industry scenario where the director works with previs artists who generate the previs for the director. By working closely with a director in this way, previs artists benefit by gaining additional knowledge in cinematographic knowledge which the director shares with them during the previs production [1].

In terms of resources required, the project may reveal that we need to create a library of 3D assets such as characters, props, environments and so forth that can be used in previs construction. This could be an area to which animation and games students could contribute. Students from these areas who have modelling expertise could create models for the library via course assessment items and projects.

Finally, the potential to set up a non-profit professional previs studio at the college is also a possibility. At such a facility students could undertake previs work for external clients or other areas of the university and gain valuable industry experience.

Our intention at this point is to organise and execute a collaborative student project such as the one described above, and to reflect on the outcomes of this project in a final report at the end of the year.

From there, we can formulate a strategy to incorporate previs teaching across all areas of the film school.

4 CONCLUSIONS

Previs increasingly plays a central role in film and 3D animation production. As it becomes more sophisticated in its execution and more inclusive of additional aspects of the production pipeline, it has more relevance as an area of teaching in film school programs. Educators should give serious consideration to providing previs training to their students. Currently, previs does not appear to be included to any significant degree in many film school programmes, or if it is included, it's limited. Organisations like the Previsualization Society would like to see this situation addressed and they are keen to involve educators in this process. Griffith Film School's initial venture into introducing previs content indicates that it can be implemented quite easily into existing film school programmes.

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