

# Computer Graphics Educational Materials Source Policies and Status Report

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## Abstract

CGEMS, the Computer Graphics Educational Materials Source, aims at supporting a worldwide community of Computer Graphics educators. Our goal in developing this service is to provide a means for educators' work to be appraised and disseminated to other members of the community through an online server for refereed educational content. Since it was presented last year at SIGGRAPH in San Diego, CGEMS has evolved into a full-fledged peer-reviewed medium. This paper presents the current state of the server, reports on work developed and dissemination activities, but most importantly describes how and why educators should submit content.

## 1 Introduction

CGEMS addresses the needs of teachers and practitioners of a mature, yet still rapidly changing field. As Computer Graphics, Digital Arts and Media continue to evolve and reinvent themselves, educators need to master new content and computer techniques for image synthesis. To this end, teachers in all Computer Graphics and Digital Media disciplines need to develop or use readily available high-quality curricular resources. While this has traditionally been the role of textbooks, writing comprehensive textbook materials is time-consuming, which makes it very difficult to keep abreast of progress in a field that changes so rapidly as ours. Our approach aims at providing a means for educators to publish quality, state-of-the-art resources in a timely and useful manner. We have developed a web groupware application to support submitting, reviewing and archiving curricular resources, by the community, from the community, to the community.

This paper reports on the current state of our efforts, since the inception of CGEMS. We present a brief history followed by an overview of the present functionality. Then we discuss the types of materials accepted together with a rationale for doing so. We then describe the peer-review and support mechanisms for online communities added during the last few months, followed by a detailed description of content submission mechanisms. Next we discuss advantages of providing quality resources to the community as a whole. Finally we present results and activity around the server, discussing possibilities for future work.

## 2 The making of CGEMS

One of the main roles of professional associations such as SIGGRAPH is to support teachers in their main activities. This has been recognized both by Eurographics and SIGGRAPH since the 80s in a series of workshops and activities related to CG education. Notably, during the Eurographics / SIGGRAPH Workshop on Graphics and Visualization in Education (GVE '99) held in Coimbra, Portugal, educators stressed, among other things, that

curricula should focus on creative and technical concepts, over simply teaching hardware and software techniques [GVE 1999]. Computer science educators also see a changing role in their fields. Indeed, rapid change in hardware and software influence and transform the way these are used. Because of this, and for pedagogical reasons, Computer Graphics educators need to stay current with new trends and incorporate them in their curricula. Three years later, attendees at CGE'02 workshop held in Bristol [Bristol 2002] recognized this need. The CGEMS concept and the work described herein were largely borne out of these discussions.

Many debates took place during and after CGE'02 to shape the structure and policies of a curricular materials service. To serve the community of CG educators worldwide, we wanted to ensure (a) timely submission, (b) regular updates, (c) rigorous quality control, and (d) peer recognition. This led to establishing a journal-like system with several review cycles without a fixed deadline. This enables flexible review workflow and encourages timely updates of content. However, we also identified the need for regular calls for submissions, possibly at the end of each academic semester in fall and spring. In this way, we hope to get notes, assignments, and examples from successful courses, in their polished state. The next section provides an overview of the server.

## 3 Overview

CGEMS is an online server that provides curricular material for Computer Graphics educators. The system includes a method for reviewers to volunteer, contributors to submit, and editors to jury and control the quality of content to ensure sound and robust contributions. The server is available since mid 2003 and is accessible via the URL <http://cgems.inesc.pt>.

CGEMS is an emerging online referred repository for curricular materials related to Computer Graphics. It encompasses as many disciplines that incorporate Computer Graphics as possible, including computer science, math, physics, graphic arts, and "fine" art, to name a few. Indeed, both the Eurographics Education Board and the SIGGRAPH Educational Committee have sanctioned the CGEMS project.

After considerable discussion, we decided to adopt the journal model for CGEMS, including possible special issues. Indeed, while there are a few "natural deadlines" affecting educators in the field (end of academic year, semesters, professional conferences such as Eurographics and SIGGRAPH, etc), forcing the conference model on submissions could result in lesser opportunities for interaction between authors and reviewers with a negative impact on the quality of final submissions.

The current CGEMS architecture is based on a client-server communication. The end-users, authors, reviewers and the editor-

in-chief (EIC), access the system through web pages that in turn interact with a console application responsible for receiving the web applications requests, including file access, database access and sending emails. The system users, the submitted modules, modules assignment, the reviews, and other important data are all stored in a relational database that is accessed by the console application when needed.

Among its main features, the current server version supports online management of reviewing and publishing workflow. This includes awareness management for all aspects and events that arise out of a regular journal operation. Our system also provides automatic email notifications to CGEMS mailing list subscribers whenever new modules are published. One key feature introduced over the past semester was the possibility for editors-in-chief (EIC) to invite reviewers.

The system has been tested for portability with a large number of different browsers, spanning more than 80% of current Internet users' configurations.

The most relevant core services of the CGEMS proposal arising out of the CGE'02 workshop are already implemented and have been in good working order since July 2003. A call for reviewers was issued in December 2003 and a call for submissions was sent out in January 2004. We are looking to extend the core systems functionality through enlisting the cooperation of additional members from the Computer Graphics education community at large.

#### **4 Related Work**

In recent years many systems have been developed to support electronic submissions and peer-review of scholastic work, most notably for conferences as well as journals. These usually take the form of on-line web sites, which provide some degree of support for many editorial tasks traditionally done using paper and conventional communication media.

Among the systems commonly available, many are devoted to managing conference submissions. Few systems support journal publication, although most of these tend to be proprietary. In a previous submission [Figueiredo SG2003] we discussed the relative merits of the journal and conference models.

Since the beginning of the Internet, before the emergence of World-Wide Web, people used electronic bulletin boards (BBS) to connect with each other and share resources, files and other information. This was the start of online communities. Today, participation in virtual or online communities has become common in the daily lives of millions of people across the world. As described in [Preece 2000], these communities arise out of groups and individuals who mainly cooperate to share resources and satisfy each other's needs. People join online communities mainly to socialize, work together, share ideas and engage in topical conversations. To build such communities there are a few steps to follow: (1) identify a target audience; (2) determine what tools must be provided to serve the purpose; (3) determine how to host or facilitate the community; (4) build it; (5) draw in members; (6) and nurture it [Boetcher 2002]. Recent studies reveal that a shared common purpose appears to be the main indicator of success in an online community. Indeed unity of purpose is what drives people to connect, provide valuable information and to come back, not to be regarded just as non-contributors [Abrams 2003].

Beyond systems based on conference/journal metaphors, there are recent research projects which approach themes closer to CGEMS. Among these we survey the Multimedia Educational

Resource for Learning and Online Teaching project [MERLOT] aims at building peer-reviewed interactive learning resources. The main difference between our project and Merlot is that the materials in Merlot are Web-based. Furthermore, contents of target resources are not physically stored in the system. Thus, stale or broken links are a major problem that Merlot has to contend with. Additionally Merlot, attempts to target a large number of different subject matters (e.g. mathematics, social sciences, education, among others), which on one hand detracts from focus and on the other dilutes unity of purpose, which is essential for community building. Furthermore, it is not clear for prospective authors how the review process is structured and what kind of support is provided by the system to this end.

Another research project is Educational Object Economy [EOE], which aims at supporting a community of educators, programmers and managers working on educational Java objects on the web. Contents, which include Java applets, interactive simulations, illustrations, and exercises are available free of cost. The stated goal is to improve quality and availability of web-based learning materials. There is no mention of peer-reviewing techniques being brought to bear on the materials.

We have also studied SMETE Digital Library [SMETE], a system similar to Merlot that differs mainly in that some contents are neither peer reviewed nor freely available.

In sum, the main advantage of CGEMS over these systems lies in that it focuses on a single discipline (albeit large) that may prove more effective at community building. Moreover, CGEMS content is freely available for fair use. Contents are stored locally on the server, not web-distributed and are not prone to content decay and broken links.

The fast pace of change and the vast availability and accessibility of materials in the Computer Graphics field makes it difficult for educators to continually design up to date, meaningful and robust curricula that address the full potential of the technology. Although research projects such as Merlot, SMETE and EOE try to address this issue, there is currently no centralized worldwide-refereed specialized repository for Computer Graphics educational materials. CGEMS provides the primary tools for educators, students, and professionals to easily access quality refereed course materials and for contributors to share and get recognition for their curricular innovations, thus building an online community where Computer Graphics people get enmeshed in a common purpose.

Presently, as described in the previous sections, CGEMS focuses primarily on submission, reviewing processes, and workflow in order to provide the tools to support the Computer Graphics community. The goal is now to draw in more people to participate on and contribute to the project. People can participate by joining as authors and submitting modules and by volunteering to review materials. Recently we have issued a call for materials. The following sections show how to submit modules and what submitters stand to gain from it.

#### **5 What kind of submissions to accept**

We encourage members of the Computer Graphics community to submit course innovations for consideration in CGEMS. To maximize returns for the community as a whole, our materials are made available through the server for classroom use, provided the source is acknowledged. Any educator may use all submitted work for educational purposes. Fair use does not include applications of the materials for any purpose other than academic teach-

ing. Indeed, educators who download materials from the server may not distribute them outside of class or publish them in any other way. To this end, they will be asked to accept a fair use agreement before accessing such materials. Our intent in having a fair use policy is to encourage community members to submit and reuse materials freely from the server with due credit being assigned. People are not supposed to use the materials in such ways without the explicit written consent of authors.

We also restrict the media types that can be uploaded to the server. As a general rule, we prefer to host content that requires only freely-available viewers, such as X3d [X3d] or Adobe Portable Document Format [PDF]. We feel that CGEMS is not in the market for graphics tools and therefore publication on the server should not constitute an implied endorsement or requirement to buy into a commercial product.

Ideally, we would like to have content organized in modules, or a complete group of materials including notes, assignments, and examples that cover a specific subject. For example, a module could be about shading networks for 3D modeling and the materials might include course notes, interactive demonstrations, assignments, and example student work. We are currently focusing on parts or constituent modules of the introductory Computer Graphics course.

We are in the process of determining what kinds of materials we will support. Granularity of content is certainly an issue. However, single images, simple applets, and movies will be accepted *provided that* there is an accompanying document to explain and support the submission proper. Quality materials imply scholarly treatment of content. This is a distinguishing feature of whatever content is available on CGEMS from other on-line sources, which make materials available “as-is”. In our view, lack of commentary greatly reduces its value to would-be clients who may fail to see the point to a particular “gem”. In this case, description is indeed the better part of valor.

Finally, the module submission format and packaging is relevant in many cases.. However, there are many quality-teaching materials that do not fall neatly into the module format, so we also accept portions of modules, such as individual assignments or course notes. We are specifically looking for materials that fall into two main categories:

- Complete Modules – These are the preferred type of submission. A module is a self-contained, single-topic teaching unit. This includes all course materials required (images, notes, problem sets, etc.)
- Lessons / Teaching Gems – These are similar to modules but more narrowly focused bits of teaching material that highlight an approach to teaching a particular problem in either introductory or advanced settings.

We will accept the material in most common formats (PDF, Java, VRML, JPEG, GIF, MPEG, etc). The main rationale for accepting a given format will be the existence of free, publicly available viewers for that format. While the subject of proprietary formats has been thoroughly debated, we want to strive for maximum availability and usefulness of published materials.

We intend for the submission policies to help in organizing available content for CGEMS users. Although still under development, the categories or focus areas will help educators to quickly identify the proper content. Modules will also aid in streamlining the process because they will contain a complete set of materials for a subject.

## 6 Peer-review process

We feel that the added value of such a server is directly related to the rigor of the refereeing process. Not only does a refereed system ensure premium materials, but it also supports recognition of those who publish on the server. To this end we have developed comprehensive support for online submissions and editorial workflow management. We will explain these here, detailing changes implemented since [Figueiredo SG2003], the peer-review process for evaluating educational materials, and the main exchange of information between the three key roles involved in the process: authors, reviewers and editor-in-chief.

The reviewing process starts when registered authors submit their work. The CGEMS editors-in-chiefs (EIC) are responsible for managing the submissions and the reviewing and redaction processes. They are notified of each new submission and decide whether or not to accept it for reviewing. If a submission still needs some work it gets sent back for re-submission after necessary changes are made. Alternatively a submission may be rejected by the EIC after checking it against a set of minimum requirements related to content, subject, scope, consistency and *style*.

Reviewers can be either invited or selected from a pool of volunteers. Newly minted reviewers are able to choose their areas of expertise or preferences by choosing from a set of Computer Graphics and education keywords. The system allows reviewers to choose among submitted contributions those that best match their interests and expertise. Materials accepted for reviewing by the EICs are assigned to at least three reviewers based on their expertise and interest. An email notification is sent to all reviewers assigned to a submission. Appointed reviewers can reject assignments based on (1) conflict of interest, (2) the submission being out of the scope of their expertise, or (3) because reviewers have too much other work to do. Should a reviewer reject the assignment, the EIC can reassign the submission to other reviewers. Either way, the EIC gets notified of their decision.

After this initial selection, reviewers can evaluate the submissions assigned to them and write reviews. Materials are evaluated according to five main criteria: portability, technical robustness, pedagogical content, scientific content, and quality of exposition. For each of these categories the reviewer prepares an evaluation together with comments, which will later help the EIC in making a final decision. The review is summed up in an overall evaluation choosing one out of four recommendations: a) out of scope/ inappropriate; b) strongly reject; c) weak reject; d) weak accept and e) strongly accept. This is substantiated by comments sent to the authors and the EICs. Evaluations can be incrementally filled out by reviewers. They will only become final when the EIC makes a decision and reviews get sent to authors. Until then, reviewers are able to update or revise their comments as often as they desire.

To keep tabs on the process, the EIC is able to notify reviewers who are late in the delivery of their evaluation and in extreme cases, reassign the submission to other reviewers. Moreover, authors can check their submission status in order to track the review progress. Their module can be in one of several states: a) submitted; b) accepted for reviewing; c) assigned for review; d) rejected; e) sent back for revision; f) resubmitted; g) accepted for publication; h) resubmitted for publication and i) published. When all reviews are written and submitted into CGEMS, the EIC makes a final decision on whether the submission is accepted, must be revised according to comments, or rejected. This decision is sent via email to the contact author.

Modules sent back for revision can be reformulated and resubmitted by authors. The revised submission will then undergo a new review cycle. Authors of submissions accepted for publication can decide whether to submit a final version based on the EIC and reviewers' comments.

For accepted contributions, the EIC checks the final submissions for problems, e.g. to see if the documents contained in a module are printable or whether they require additional formatting. Authors are notified of any required changes and can resubmit their work based on the EIC comments. More iterations can occur if the EIC feels the module still needs some changes before it is finally catalogued as a published contribution. This cycle is part of the redactional pipeline, which is different from the previous review cycles.

Once modules are considered ready to be published in the CGEMS server by the EIC, they are catalogued as accepted contributions and made available to others for viewing and downloading. All subscribers of the CGEMS mailing list whose interests match the categories ascribed to the published module receive an email message. This contains detailed information on the newly accepted contribution. Figure 1 details the most important steps in the review process presented above.

## 7 How to submit

In order to submit modules, authors must first register to the system. After filling in the *author registration form* the system creates a unique password and sends it to the new registered author via email. Once logged in to their personal web page, authors are able to perform many tasks as described in [Figueiredo SG2003]. Most notably, they are able to submit or resubmit materials and check the status of different submissions. Module submissions are performed in two steps: (1) fill in information and details concerning the submission; (2) upload the submission file.

During the first step authors must provide useful metadata to describe their submission as described in what follows:

- **Personal info** and details such as the contact author name, institution, phone, fax and email address;

- Number of **additional authors** and their contact details (name, institution and email address);
- **Title** of work and **abstract** (summary describing the submission). The abstract is used by reviewers to select submitted materials to review and by educators to identify materials published on the server;
- Main **keywords** that describe the submission. These keywords are used during the module assignment process and are later used by educators to search and identify appropriate materials available in the server;
- Specific **instructions** on how to install or work with the submission contents (remarks section), for example the need for certain extensions to be enabled or disabled, or the files that need special processing or installation;
- Submission **requirements**, which not only include hardware or system specifications, but also include a list of software (requirements section). For example, in a course on shading networks, the notes might specifically describe how to create those networks using Maya software. In this case, Maya software would be listed as a requirement. We would like to stress that submissions that do not require specific commercial packages might be more generally useful to wider audiences;
- **Intended audience** for this submission. Is the module designed for elementary school art classes or college level graphics programming? This will also help educators identify appropriate courseware;
- **Prerequisite courses or knowledge** since most courses assume some level of experience or expertise in a given discipline. A general list of skills necessary for the course material;
- **Language** used in the module;
- **Submission type** as described earlier.

The submission process ends with selecting a file for uploading. Currently, submissions must be compressed in zip format and uploads are limited to 10MB in size. Authors of larger submissions are asked to contact the CGEMS team.

## 8 Why submit?

To serve CG educators worldwide, CGEMS makes it possible for community members to submit their materials in a timely way. Usefulness of content is also promoted through regular updates and rigorous quality control. Indeed, publishing to this refereed materials source ensures peer recognition, backed by the foremost professional associations in Computer Graphics. Regular calls for submissions and our promotion efforts encourage other community members to participate. Our current effort is targeted at enticing people into using the server and arousing their interest. By publishing in CGEMS, educators can make their work accessible to a community that includes hundreds of people worldwide (400+ at the time of this writing).

## 9 Discussion and First Results

From an earlier prototype developed in August 2002, CGEMS is currently available and hosted in an independent server installed

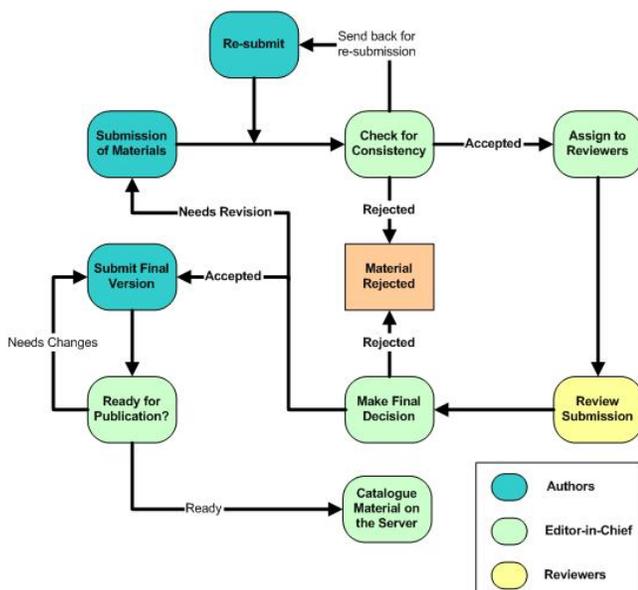


Figure 1: CGEMS peer-review workflow

at the Portuguese National Foundation for Scientific Computation (FCCN). As of this writing CGEMS is fully accessible using most popular browsers on the market such as Internet Explorer 5.0 (or higher), Netscape 7.0 (or higher), Mozilla 1.1 (or higher), Opera 6.04 (or higher), and Netscape 4 browsers. We have made available a demo version in parallel with the functional server to allow users to experiment all the functionality and workflows. The CGEMS demo version can be visited by accessing the URL <http://cgems.inesc.pt/demo>.

The design and implementation of the server has also been presented and discussed both at SIGGRAPH03 [Figueiredo SG2003] and Eurographics'03 [Figueiredo EG2003] Education programs. At the time of this writing the server beta 0.4 version is available. We have issued the first call for reviewers, followed by the first call for contributions. The editorial board includes 29 registered and accepted reviewers from all over the world, 13 volunteer applications waiting to be accepted or rejected, 71 invited reviewers who have not yet decided to accept or reject their invitations. 25 authors have expressed interest in submitting modules or otherwise participating in the community. Several submissions are already in the pipeline in all stages of reviewing process.

The CGEMS main page is now seeing an average 25 page-views per day since the beginning of 2004, twice the figures tallied since September 2003. These figures also show a steady increase over the past months and are likely to be significantly higher at Los Angeles.

With an Editorial Advisory Board in place, reviewers have started to submit volunteer applications and the first submissions have started to flow in.

We are currently working on proving multilingual support for the server in order to enhance and extend the server's reach to the CG Educators community at large.

## 10 Conclusions and Future Work

While Computer Graphics has matured in many aspects, it is still experiencing rapid growth and phenomenal evolution in applications and research. This presents challenges to educators who need to keep abreast of the latest developments while creating high-quality teaching materials.

We feel that CGEMS provides excellent foundations for supporting the community of Computer Graphics teachers and professionals as a whole. Its added value is directly related to the rigor of the refereeing process. Not only does a refereed system ensure the availability of premium quality materials. It also supports recognition of those people who publish on the server. To this end, we have developed comprehensive support for online submissions and editorial workflow management. Future versions will add extended community services and more sophisticated publication and redaction management services. It will also include extended community services, such as user comments and ratings for specific modules, mailing lists, advanced search mechanisms, and email notifications of server activity. Along with these added features, we will continue to evaluate the success of the functionality and processes and make changes when necessary.

The site is now accessible from a number of reference places, most notably from the SIGGRAPH and Eurographics home and education pages. Our long-term goal is for CGEMS to become the premier resource for Computer Graphics educational materials. While much work remains to be done, we feel confident that CGEMS can serve as a cornerstone in supporting the world-wide community of computer graphics educators.

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