# A Refereed Server for Educational CG Content

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**Abstract**

*Computer graphics has evolved considerably over the past few decades. As computer science, digital arts, and other areas of study that use computer graphics continue to evolve and gain new substance, educators have come to master new content and achieve deeper understandings of computers and imagery. As the core field becomes more mature, educators in all computer graphics disciplines have a greater need for high-quality curricular resources. Offering excellent educational materials is an important service to the community of educators. Such support will empower both young and seasoned educators alike to benefit from and contribute to the work of others. In this way, we can achieve a higher standard of teaching worldwide.*
*The purpose of our work is to provide tools to foster such a community of computer graphics educators. We will present a system that will act as the means for their work to be appraised, assessed and made available to others through an online server for refereed educational content in computer graphics.*
*In this paper we describe the basis for and highlight some of the starting requirements of CGEMS, the online Computer Graphics Educational Materials Server. This is organized around a web-based groupware application that supports the submission, review, acquisition, and archiving of curricular resources.*

Categories and Subject Descriptors (according to ACM CCS): I.3 [Computer Graphics]: General K.3.2 [Computers And Education]: Computer and Information Science Education

## 1. Introduction

The Computer Graphics Educational Materials Server (CGEMS) is an online system that provides curricular material for computer graphics educators. The system includes a method for contributors to submit and editors to jury and control the quality of content to ensure sound and robust materials. The shape and components of CGEMS arose from fruitful discussions around, during, and after the Workshop on Computer Graphics Education (CGE02) held in Bristol, UK in July 2002. Figure 1 shows the initial page of CGEMS.

The fast pace of change in the computer graphics (CG) 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 small systems and groups of people exist who are trying to address this issue, there is currently no centralized worldwide-refereed repository for computer graphics educational materials. Our system supports a way for educators to easily access quality course materials and for contributors to share and get recognition for their curricular innovations.

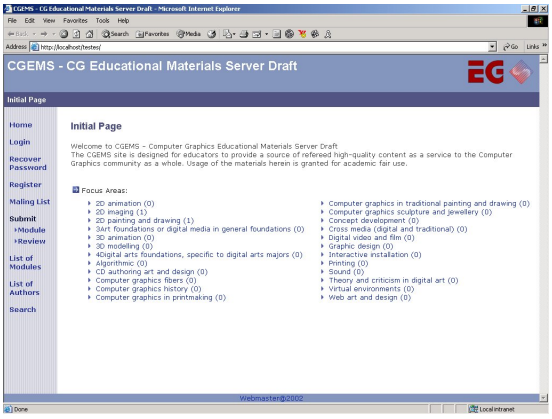


**Figure 1:** *CGEMS Initial Page*

To achieve its goals CGEMS supports submission of, and access to a comprehensive set of materials on all subjects relevant to teaching CG. Acceptable materials range from course mechanics including syllabi, lab notes, example assignments, problem sets, annotated student work, such as images and interactive videos, to teaching gems, presentation slides, course notes and interactive demos. To encourage maximum reusability and to promote dialogue among the community, the preferred modality of submission is the course module. A course module is a self-contained teaching unit including some or all of the above materials as parts to an articulated whole. Examples of these are transformations in CG, principles of texturing, shading techniques that impact the mood of a narrative, concept development, etc. Typically a course can be construed as an articulated set of modules organized according to pedagogical criteria.

Another important criterion for success is to ensure maximum usability and accessibility of materials. As such we encourage submission in vendor-neutral formats.

To ensure quality materials, the server implements a thorough refereeing process similar to that of a journal.

The current CGEMS architecture is based on a client-server communication as shown in Figure 2. The clients, 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.

In what follows we present an overview of CGEMS in which we discuss the rationale for the policy decisions we made. Next we describe related work. After a section discussing the editorial policies in place we discuss the current status of the implementation followed by conclusions and future work.

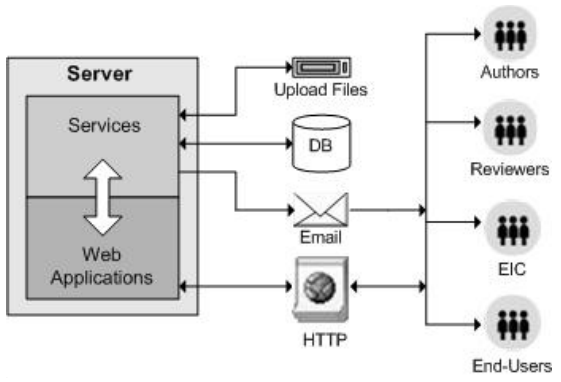


**Figure 2:** *CGEMS Architecture*

## 2. Motivation

Keeping up with the rapid changes in computer graphics and digital media alone present a challenge, but became even more formidable for those who teach others how to use it for artistic or scientific goals. Not only do educators need to understand digital media and what to do with them, but they also must help others to achieve that vision and discover innovative approaches to computer graphics and creativity. To add to this complexity, many digital innovations afford ways of thinking that not only extend what has come before, but also provide novel functions that invoke unique ways of thinking. So, along with understanding the medium and how to be creative with it, computer graphics educators must also discover innovate ways of thinking that new technology arouses. Once they master the latest technology and its implications, educators must invent assignments and lessons to convey that innovation to their students.

The task of CG educators entails developing the appropriate language to describe what new digital media are and how they can be made useful. Lev Manovich in Language of New Media? describes this as an attempt to create "...both a record, and a theory, of the present." He further states that the aim of such an endeavor is "...to describe and understand the logic driving the development of the language of new media."

Describing new media is especially important to people in the computer graphics field, both in the sciences and the arts. The impact on digital artists lies in grasping the meaning, because the description elicits an understanding, and that understanding, in turn, allows artists to either make commentaries about digital art with the medium or successfully use it as a tool. In either case, a technical landscape that changes every six months does not provide much time for educators to produce useful courseware in a timely manner.

The role of professional associations is then to support educators in their core activities. This has been recognized both by Eurograhics and SIGGRAPH since the 80's in a series of workshops and activities related to CG education.

During the Eurographics / SIGGRAPH Workshop on Graphics and Visualization in Education (GVE '99) held in Coimbra, Portugal, art educators stressed, among other things, that curricula should focus on creative and technical concepts, over simply teaching hardware and software[10]. Computer science educators also see a changing role in their fields. Indeed, as CG as a whole matures, much of the emphasis shifts away from teaching the minutiae and foundations of the discipline to the interrelations of latest developments and their applications. Still, the changing hardware and software influence, and in some cases transform, the way these are used and what creative expressions can be borne out of them. Whether in arts or science, new technology does not change creativity. Rather, it changes our understanding of art or science problems and enables us to observe things

that we did not see before[11]. Because of this, and for pedagogical reasons, computer graphics educators need to stay current with new CG trends and incorporate them in their curricula. The CGE'02 workshop held in Bristol[5] recognized this need and set the foundations to develop CGEMS.

## 3. Editorial Policies and Structure

Many debates took place during and after CGE02 to shape the structure and policies of CGEMS. 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, there will be 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.

Authors can update their materials in subsequent editions. These get assigned a new version number to differentiate from older versions. The new versions will also be refereed and do not replace older versions. Users will be able to make comments and rate modules, which will help authors with newer versions and other users to identify useful materials.

Authors will submit work only after they have registered in the system, which will issue a password via email that the author will use to submit and modify submissions. Although this is not fully secure, it will discourage would-be hackers. Authors will also be required to ensure that all materials are free from copyright and can be used and downloaded by users. Table 1 lists a subset of most commonly used formats.

While most if not all the materials currently assembled are written in English, we envisage and encourage both localizations and submissions in different languages, including Portuguese, German, French, Spanish, etc. The general editorial structure of CGEMS includes one or more editors-in-chief (EIC) and an editorial board. The editorial board will both review submissions in their given expertise and solicit outside reviewers in specific disciplines for input. Additionally, as explained in detail later, a volunteer reviewer can register through the CGEMS system and members from the editorial board will deny or accept and place her or his application.

The editorial board will also be responsible for soliciting content submissions as well as advising the EICs on quality control of the server and identifying needs for under-covered curricula.

### 3.1. Submission Policies

We encourage members of the computer graphics community to submit course innovations for consideration in CGEMS. In order to submit, authors must first register through the online server. Once complete, they will have a personal web page that they will be able to use to submit modules, change their login password, change their personal details, and check their submission status and information, resubmit modules, or interact with the editorial board concerning their submissions. The details of this process were covered as part of a presentation at the SIGGRAPH 2003 educators program. The submission policy includes the content authors may submit, information that authors need to provide, categories or focus areas, and fair use policies.

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.

There are many quality-teaching materials that do not fall neatly into the module format, so the CGEMS server will also accept portions of modules, such as individual assignments or course notes. We are specifically looking for the following materials:

1. **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.)
2. **Annotated Course Syllabi** - These serve mainly as a best-practices repository. A complete course syllabus provides not only a set of educational units, sequences, pedagogical approaches, but also the rationale behind the choices made by the educator in preparing the course. Ideally, course reports could complement the syllabus to enrich the usability of these submissions.
3. **Lab Notes** - Again these are complete sets of materials with a complete discussion to serve as exemplar presentations and foundations for educators to prepare their own laboratory sessions.
4. **Problem Sets** - These are provided much in the same vein as lab notes. A problem set should not only contain the assignments themselves, but also the rationale and structure underlying these.
5. **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.
6. **Annotated Student Work** - such as images, interactive pieces, URLs, videos, etc. These are representative bodies of student work that can in turn be used as support materials for classes.

We will accept the material in most common formats. See Table 1 for a list of formats.

When submitting the work, authors will be asked to provide information about themselves and their submission. In addition to name (s), content, and actual submission, the authors must prepare keywords, an abstract, system and soft-

| Text / Slides | Images | Video | Interactive media |
|---|---|---|---|
| HTML | GIF | RM | VRML |
| PowerPoint | JPEG | MPEG | Director |
| Word | PNG | AVI | Java |
| LaTeX | TIFF | Quicktime | Flash |
| PDF | SVG | | |

**Table 1:** *Some of the more common formats*

ware requirements, instructions, the type of submission (assignment, module, etc), prerequisites, the intended audience, and subject categories. These keywords will help educators search for and identify appropriate materials available on the CGEMS server. The requirements include not only hardware or system specifications, but could also include a list of software. In the case of the shading networks example, the course notes might not be conceptual and specifically cover how to create them using Maya software. In this case, Maya software would be listed as a requirement. Other notes on shaders, for example, might be more general and only require any 3D modeling software.

Finally, it is important that authors include specific instructions about how to work with their submission. Perhaps certain extensions need to be enabled or disabled or the files need special processing or installation. The author will include instructions such as these in the remarks section. To be accepted, a submission will not only need to work, but it must be clear how to implement the content.

Because most courses assume some level of experience or expertise in a given discipline, authors will be asked to include prerequisite courses or knowledge. This will help other educators identify the appropriateness of a module or material. Although this sort of classification is not universal, a general list of skills necessary for the course material would be sufficient.

Related to the prerequisite experience is the intended audience. Is the module designed for elementary school art classes or college level graphics programming? As with the prerequisites, this will help other educators identify appropriate courseware.

Because we accept educational material associated with computer graphics from any discipline, it is important for authors to correctly identify their submissions in categories, or what CGEMS refers to as focus areas. These are specializations within a discipline that the materials cover. For example, focus areas within the arts include digital imaging, 3D modeling, and digital video. See appendix A for a full list of art focus areas. Similar lists do not yet exist for computer science and general science, although they are expected to appear in the near future, partially as a result from the CGEMS effort.

Finally, any educator may use all submitted work for educational purposes. Fair use does not include applications of the materials for any purpose other than teaching. Educators who use the materials may not distribute them outside of class or publish them in any other way. Educators who download materials will be asked to accept a fair use agreement before accessing materials. Our intent in having a fair use policy is to encourage educators to submit and reuse materials freely from the server with due credit being assigned.

We intend for the submission policies to help streamline the content for those who will use CGEMS. Although still under development, the categories or focus areas will help educators 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 or perhaps an entire course. However, separate assignments will also be helpful as long as they can be identified by focus area and type.

### 3.2. Editorial Policies

The CGEMS server will contain quality educational materials that will be dependent on rigorous reviews and continual updates. The general editorial structure of CGEMS includes one or more editors-in-chief (EIC) and an editorial board. The editorial board will both review submissions in their given expertise and solicit outside reviewers in specific disciplines for input.

The editorial board will also be responsible for soliciting content submissions as well as advising the EICs on quality control of the server and identifying needs for under-covered curricula. Further details of the editorial structure were covered as part of the SIGGRAPH 2003 Educators Program.

The reviewers will be asked to screen materials on a number of different levels with some reviewers checking specific criteria. All general reviewers will examine materials for pedagogical content and the quality of student examples. By pedagogical content we mean the relevance of the assignments and notes to the specified focus area and the overall flow of the courseware. Referees will ask questions such as, "Are the materials designed for optimal learning outcomes?" They will additionally review the overall structure of the submission for things like readability and grammar.

Other reviewers will inspect the portability of software, examples, and other content when applicable as well as the robustness of assignments and examples. When the need arises, they will test examples and try out software.

Reviewers will also be responsible for making the editorial board or the EIC aware of outdated materials. Authors will be given the opportunity to update materials and classify them as newer versions. The amended materials will be reviewed in the same manner as the original work.

CGEMS will rely on an efficient review cycle that will require the reviewers to make decisions about submissions in a timely manner. The success of the server will depend on reasonable turnaround time and strict enforcement of quality publications. The level of excellence will be monitored by the reviewers, but will also depend on feedback from the user community. In the future we hope to implement a way for educators to rate and comment on the success or applicability of any given material.

## 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, although many systems support journal publication. The main differences between conference and journal management lie in workflow and deadlines. Conferences typically have submission deadlines and a shallow review pipeline due to rigorous timing constraints. These limit review and acceptance cycles to one or two at most. Moreover, conferences tend to set limits on the number of accepted technical contributions due to a limited number of presentation slots. As a result, selective conferences may reject technically sound, quality papers. On the other hand, journals tend not to operate on pre-set deadlines (save for special issues), but rather on absolute technical merit of submissions. Resource limits arise from publication and distribution schedules on paper journals, which constrain the maximum and minimum number of printed pages per issue. An on-line journal, on the other hand, is free of such limits. Because consumers pay for distribution costs when downloading, the fixed charges are just the space occupied on physical disks. Given the ever-shrinking cost per megabyte of storage these tend to be marginal. In this manner, journals tend not to set rigid deadlines, but can afford long review cycles and "deep" pipelines, where a given submission may be refereed several times before being accepted for publication.

On-line submission systems for conferences tend to be available more or less free of charges to the academic community, while most on-line journal management systems require some form of licensing and payment of fees. This is due to the different uses and needs of the different communities. While conferences tend to be organized by academicians and scientists on a voluntary basis, journals are traditionally run by publishers who, naturally expect to run a profitable venture.

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.

Among the many systems available[1], Cyberchair[6] is among the best known and used. One interesting feature is that it offers support for most of the editorial/administrative tasks that we intended to support from the start. Further, the source code is freely available for academic use. However, many of the tasks are hard-coded into modules and the system proved difficult to adapt to our needs. Another excellent reference is Conference Review[7], which provides an excellent user interface but is not available as open source. Journal refereeing systems[14] in principle would be available as a basis to support our development. However as we mentioned above, these tend to charge fees, even for academic purposes, let alone providing access to their source code for modification.

For a fee, systems such as Bench>Press[4] claim to be customizable although this may take several months and can only be done in-house by the original developers. Other systems such as AllenTrack[2] are only accessibly remotely from a corporate server, which does not make them particularly useful for our purposes. Systems such as EditKit? and BioMed Central[3] seem to have been custom-developed for special applications and the support for editorial workflow is not clearly developed. Other systems such as Rapid Review[13] do not offer on-line support for many editorial tasks. The systems that seem to offer more complete support for the editorial and review process such as Bench>Press and Editorial Manager (EM)[9] do not make it clear how submissions are circulated to reviewers. Nor are details provided concerning workflow management and how to handle conflicting reviews. Another important criterion is browser and platform independence, which are usually glossed over by most systems.

In sum, most systems reviewed exhibit different shortcomings. We could find no general-purpose freely available system that we could readily adapt to our purposes. Therefore we decided to implement our own review and publication system. In the next section we describe the reviewing system and workflow.

## 5. Managing Workflow

In this section we describe the workflow for the process of submitting, reviewing and publishing educational content in the CGEMS server. We explain the interchange of information between the authors, reviewers and editor-in-chief, which are the three major roles in this procedure.

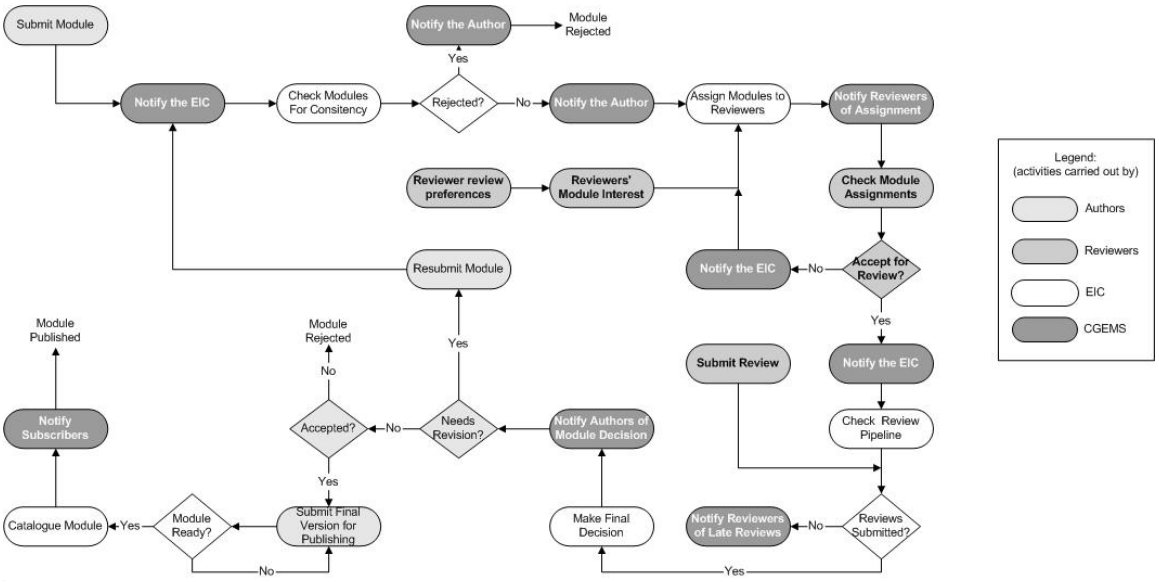


**Figure 3:** *CGEMS overall workflow*

In general, the reviewing process starts when registered authors submit their work for possible publication in the refereed server. The editor-in-chief (EIC) starts by checking these new submissions against a set of minimum requirements related to the subject, scope, consistency and style. Submissions that satisfy the criteria are accepted by the EIC for review, while those that do not are rejected. Independent of the EIC decision, the system notifies the contact authors via an email message about the new status of their submission. The system makes accepted contributions available to all reviewers so that they can express interest in reviewing them. Later, the EIC assigns accepted works to at least three reviewers, according to their preferences and expertise. A notification is sent via an email message to all assigned reviewers, who have the option to accept or reject the EIC assignments. Should the reviewer reject the assignment, the EIC will reassign it to another reviewer. After all reviewers have produced and submitted their module reviews, the EIC decides whether a submission is accepted, whether it must be revised according to reviewers' comments, or whether the module is not accepted for publication. The EIC decision is sent to the contact authors through an email message. Authors of submissions accepted for publication can decide whether or not to submit a final version based on the EIC and reviewers' comments. The EIC then checks and prepares the final submissions for any idiosyncrasies such as checking if the documents contained in a module are printable or if they require additional formatting. Once these are considered ready to be published in the CGEMS server by the EIC, they are catalogued, classified as accepted contributions and made available for downloading. All subscribers of the CGEMS mailing list whose subscription matches the module being published receive an email message with detailed information on the new accepted contribution. The detailed workflow is shown in Figure 3.

We will now present in greater detail the main tasks performed by authors, reviewers and EIC.

### 5.1. Authors

Authors must first fill in an author registration form before being able to submit their work into the CGEMS server. If the registration process is completed successfully, authors will receive an email message with their username, which they choose in the registration form, and the password that

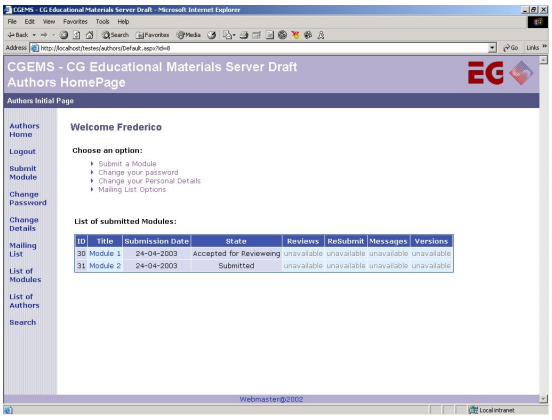


**Figure 4:** *CGEMS Authors Initial Page*

they can use for future accesses to the server. When authors log into their personal pages they are able to: submit modules, subscribe or unsubscribe, change their CGEMS Mailing List subscription, change their login password and personal details, check the status of submitted modules, interact with the EIC concerning the submissions that were accepted for publication, check and download all published modules, check authors who have already published under CGEMS, and search for both published modules and authors. Figure 4 shows the authors' initial page.

To submit and resubmit their work, authors must fill in a module submission form where they provide information about themselves and their submissions, including the author's contact submission title, keywords, an abstract, system and software requirements, instructions or remarks, prerequisites, intended audience, subject categories and submission type as described earlier, and their submission as a compressed file. After the first submission, modules are sent to the EIC who checks them against formal grounds and decides whether they are accepted or rejected for reviewing. In either case, authors receive an email notification of the EIC's initial decision. As described earlier, accepted contributions are assigned to reviewers. Based on the reviewer evaluations, the EIC can reject, send back for revision, or accept the submission for publication without the need for major changes. Authors are again notified of the EIC's final decision. Modules sent back for revision can be later reformulated and resubmitted by authors based on the reviewers' comments. The revised submission will then be reviewed as part of a new review cycle.

During the review process, authors can check their submission status in order to follow the review process. A submitted module can be in one of several states: a) submitted; b) accepted for reviewing; c) assign for review; d) rejected; e) sent back for revision; f) resubmitted; g) accepted for publication; h) resubmitted for publication and i) published.

Authors of accepted submissions can still review and resubmit a final version for publication based on the anonymous reviewer and EIC comments. Further resubmissions can occur if the EIC feels the module still needs some changes before it is finally catalogued and classified as a published contribution.

### 5.2. Reviewers

Reviewers can volunteer to join CGEMS by filling in a reviewer volunteer form where they indicate their personal data and review preferences, which are based subject categories. Later, the EIC decides whether or not to accept these volunteers as reviewers for the CGEMS server. Reviewers can also be registered in CGEMS by the EIC, who will fill out a reviewer registration form for them. In either case, reviewers receive an email message with the username (chosen during the volunteer/registration form) and password which they can use to log into their personal web pages. They are then able to: subscribe, unsubscribe, or change their CGEMS Mailing List subscription, change their login password and personal details, choose and change their areas of review preferences, choose which modules they would like to review, check assigned modules, decide which assigned modules they would like to review, check and submit reviews for modules accepted for reviewing, check submitted reviews, check other reviews made to assign modules, check and download all published modules, check authors who have already published under CGEMS and search for both published modules and authors. In Figure 5 we can see the reviewers' initial page.

Reviewers receive email notifications about all modules assigned. After logging in to their personal web pages, they can check the list of new assigned modules and decide whether or not they want to review them. Reviewers can reject assignments because of a conflict of interest, a submission is out of the scope of their expertise, or just because reviewers have too much work to do. The EIC receives an email notification with the reviewers' decision.

Modules thus accepted for reviewing can be downloaded from the reviewer's personal web page. After formulated, reviews can be submitted through a submit review form in which reviewers evaluate the modules on the following optional areas: portability and technical content; pedagogical content; scientific content and quality of exposition. In all of these categories reviewers can assign an evaluation and write his or her comments. Besides the mentioned ones, reviewers have to make a final decision about a module based on the following classification: a) out of scope / inappropriate; b) strongly rejected; c) weak rejected; d) weak accept and e) strongly accept; and fill in comments to both authors and the EIC. These comments will later help the EIC make the final decision about accepting or rejecting the module.

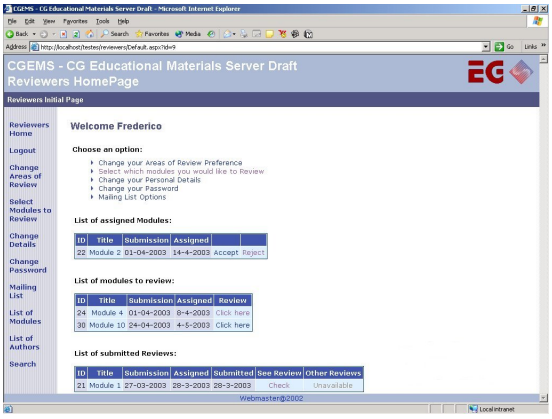


**Figure 5:** *CGEMS Reviewers Initial Page*

### 5.3. Editor-in-Chief

The CGEMS editor-in-chief (EIC) is the person responsible for managing the submission, reviewing and redactorial process. After logging into his or her home page, the EIC is able to: invite reviewers to join CGEMS, approve or reject reviewing volunteers, check all modules and their history (versions, reviews, etc.), check new submissions and decide whether or not they are accepted for reviewing, assign, invite, or reassign reviewers to review accepted modules, and check the review pipeline, which includes checking the review process and deciding on the module acceptance for publication. Additionally, the EIC can check the redactorial pipeline, including sending messages to the author, view modules, catalogue and classify modules as published contributions, check all registered reviewers and their information, check all registered authors and their information, manage the CGEMS subject categories, and change some of the CGEMS configuration information. Configuration information includes the SMTP email server, interval of notification days for late reviews, enable disable reviewers for checking other reviews, etc. The EIC initial page is shown in Figure 6.

Besides checking for new submissions and assigning modules to reviewers, the EIC's main task is to monitor the review and redactorial processes by checking both review and redactorial pipelines. In the former the EIC is able to check the status on all reviews and send reminders to reviewers who are late in submitting their evaluations. In extreme cases the EIC can assign the selected module to another reviewer. When all reviews for a selected module have been produced, the EIC checks and resolves any existing conflicts and decides whether a submission is: a) accepted for publication; b) must be revised according to the reviewers' comments; or whether it is c) not accepted. Independently of the EIC's decision, an email message containing the EIC's final decision and feedback is sent to the module's contact author.

Modules accepted for publication are sent to a redactorial cycle and can be viewed through the redactorial pipeline web page. It is the role of the EIC to prepare the accepted contributions for publication. This may involve some extra formalisms as mentioned earlier, but more importantly, cataloguing and classifying accepted contributions so that they can be retrieved and download at a later time. This pipeline enables the EIC to send messages to the authors requesting changes to be made on the current accepted versions, which will lead to new submitted versions in the redactorial cycle.

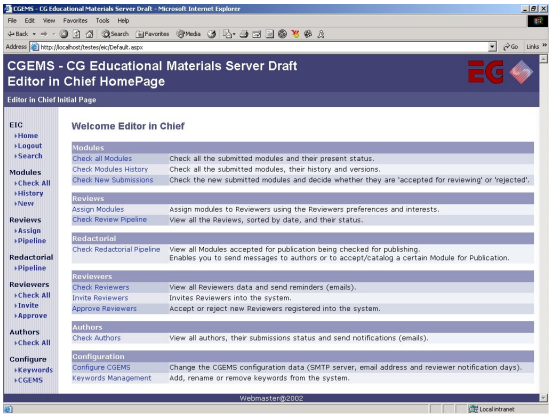


**Figure 6:** *CGEMS EIC Initial Page*

### 5.4. Management Awareness

Throughout the previous sections, we described how the server sent informational email messages to participants. One of CGEMS greatest features is a complete automated notification mechanism that significantly reduces the user's need to logon to the system as it keeps them informed of the refereeing activity happening on the server. For example, an author does not need to frequently access CGEMS to check if his or her submissions have been accepted or rejected for reviewing, because this information is sent via a system generated email message.

The server sends email messages in the following situations: authors receive a notification every time the module status changes; reviewers are notified when they have been assigned or invited to review accepted submissions and when they are late in submitting their evaluations; the EIC receives notifications when authors register, when reviewers volunteer, when an author submits a module, when a reviewer submits his module review, an when a reviewer decides whether or not to review assigned modules.

### 5.5. Current Implementation

From an earlier prototype developed in August 2002, CGEMS is currently available and hosted in an independent server installed at INESC. The current efforts are the outcome of a project in digital publishing partially supported by the European Commission, Eurographics and the SIGGRAPH Education Committee. A team of two developers, Frederico Figueiredo and Sónia Assunção, coded the initial application, web design and layout of CGEMS pages. Their design and layout definition were based on previous studies made on how to design web pages with good usability levels. Rhonda Schauer helped with the current design, layout and wrote the stylesheets for CGEMS. The current version works as a collection of ASP modules, although the server is in the process of being recoded in Java to ensure server platform neutrality.

### 5.6. Browser Compatibility

One of the major goals during the design and development of the web applications that give support to the CGEMS server was to make the user pages browser independent in terms of

both interface design and interactive functionality. This was accomplished with a large set of commonly used browsers. The current CGEMS implementation fully works with 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. Currently we are currently working on small layout problems with Netscape 4.

The current implementation of the CGEMS server can be viewed and experimented with through the following URL: `http://cgems.inesc.pt`.

At the time of this writing we are finalizing the server and performing integration and portability tests. By the time of SIGGRAPH'03 we expect the first call for contributions to be complete the first accepted submissions to be coming out of the reviewing pipeline. Our major aim is to make the server available to the community of CG educators worldwide by Fall 2003.

## 6. Discussion

This section discusses the current implementation, foremost advantages, and supposed shortcomings. Among CGEMS main features are online registration for authors, reviewers and Mailing List subscribers, the ability to submit educational modules, reviews and other information online. In addition the current version supports online management of all reviewing and redactorial workflow. This includes awareness management for all aspects and events that arise out of a journal operation. Our system also provides automatic email notifications to CGEMS Mailing List subscribers whenever new modules are published. To foster interactions within the community of CG educators, authors and reviewers alike are able to access the system with only one username and password for a given user. Subject to EIC approval, users can volunteer online to review submissions. The EIC is also able to assign modules based on stated preferences and interest in particular modules expressed by reviewers. Reviewers are able to decide whether or not they want to review their assigned modules.

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

The current implementation still falls short on several desirable services for community support such as user comments and ratings. However, we plan to add these in the near future.

The most relevant core services of the CGEMS proposal arising out of the CGE02 workshop are already implemented and in good working order. Both the core submission and review system functions are implemented and tested. We are looking to extend the core systems functionality through enlisting the cooperation of additional members from the computer graphics education community at large.

## 7. Conclusions and Future Work

While computer graphics has matured in regard to basic concepts, it is still experiencing rapid growth and phenomenal evolution in applications and research. This makes for an extremely dynamic environment and presents challenges to educators who have a need to keep abreast of latest developments while developing high-quality teaching materials. We have presented an overview and high-level description of CGEMS, a refereed content server for CG educational materials. CGEMS aims to provide basic services to the worldwide community of CG educators through refereed content. However this does not prevent using the server to also host non-refereed information.

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. The prototype system is now online. In order to have initial publications of refereed content by SIGGRAPH 03, we plan to launch a call for volunteers and submissions shortly. Future versions will add extended community services and more sophisticated publication and redactorial management services, as well as extended community services.

In the future we plan to implement services that further support the community, such as user comments and ratings for specific modules, mailing lists and advanced search mechanisms. Along with these added features, we will continue to evaluate the success of the functions and processes and make changes when necessary.

We hope to mirror the site in a number of locations, including highly visible sites such as the SIGGRAPH server. Our hope is for CGEMS to become the primary centralized resource server for computer graphics educational materials. While much work remains to be done, we feel confident that CGEMS can serve as a cornerstone in supporting educators in spreading the gospel of computer graphics.

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## APPENDIX A

### Digital Arts Focus Areas

- 2D imaging
- 2D painting and drawing
- Art foundations or digital media in general foundations
- Digital arts foundations, specific to digital arts majors
- 3D modeling
- 2D animation
- 3D animation
- Graphic design
- Web art and design
- CD authoring art and design
- Interactive installation
- Virtual environments
- Digital video and film
- Concept development
- Computer graphics history
- Theory and criticism in computer art
- Cross media (digital and traditional)
- Algorithmic
- Sound
- Printing
- Computer graphics in traditional painting and drawing
- Computer graphics in printmaking
- Computer graphics fibers
- Computer graphics sculpture and jewelry