Joining Educational Mathematics[1]

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Abstract. The eContentPlus thematic network JEM, Joining Educational Mathematics, has been active for one year in raising awareness and promoting proper use of technology for eContent in mathematics. This paper briefly describes the network, its activities and its objectives.

Keywords: eLearning mathematics, eContent, network

1. Introduction

Recent technological advances regarding the representation of mathematics on the web make it possible to create and to deliver high-quality, reusable, interactive mathematical content to students' computers worldwide. Centers of excellence in mathematical research and education are scattered across the continent and all too often their effort fail to add up in the absence of an efficient system for collaboration and for communication between technology developers and authors of eContent.
The JEM, Joining Educational Mathematics, thematic network addresses the need to improve the didactic tools and the teaching materials in mathematics. Its goals are to

- pool together the required expertise
- contribute to the coordination of content enrichment activities in the area of mathematics,
- promote standards and best practices,
- deliver synoptic high-quality user information and support pages.

The range of awareness activities promoted by JEM are addressed to educational content stakeholders in mathematics and focus on the benefits of enriching digital content with semantic markup. Additionally, technology developers are exposed to the concrete requirements of authors of digital content. JEM enlists the leading developers of the technologies as instructors and tutors for author of eContent and, as a result, distributes best practice sample material via established servers of major universities, commercial publishers and professional societies. The JEM portal (1) offers a social networking platform that identifies the community of experts in high-quality eContent for eLearning mathematics. By supporting authors, developers and distributors, the JEM portal ensures that a constant flow of information on the production of eContent is available and recorded in terms of reusable documentation.
The JEM network aims to contribute to the creation of curricular content showing greater compatibility within European higher education in mathematics in the spirit

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advocated by the Bologna process. Implementation of the European Credit Transfer and Accumulation System will be more easily achieved if high quality courses and curricula can rely on a common repository of educational content, on commonly agreed entry tests and assessment exams. Moreover, by strongly promoting cooperation in quality assurance it aims to show that technological innovation applied to learning has the potential to provide an opportunity to all.

2. Network Members

The JEM network currently enlists 20 nodes each characterized by a main role as eContent stakeholder for the area of mathematics, physics or statistics education. The Network started with 16 founding members and has acquired 4 new members during the initial 12 months thus establishing itself in Finland, Germany, Greece, Italy, Netherlands, Norway, Portugal, Spain, Sweden, and UK. In addition, the European Mathematical Society has joined the network and its president is chairing the JEM Committee on eLearning Quality. The JEM Standardization Committee is lead by M. Kohlhase, the newly appointed president of the OpenMath Society.

The technology developer partners include the leading European groups for producing advanced learning software solutions and ca offer a wide range of ICT tools to enhance mathematics teaching. They include University of Helsinki, Technical University of Eindhoven, Jacobs University and NAG Ltd, with a long tradition in research on representation and software for the electronic communication of mathematics. The commercial Maths for More together with Universitat Politcnica de Catalunya has developed the WIRIS software suite for doing mathematics on computers, with a special attention to their usability in education. University of Birmingham is responsible for STACK, a widely used software system for mathematics assessment, which generates random exercises and automatically grades the students' answers. RWTH Aachen University, Technische Universität Berlin and ISN Oldenburg offer full learning environments for teaching applications of mathematics in Statistics and Physics. Advanced multilingual software is the expertise of Chalmers University of Technology.

Several partners are experienced authors of online educational material for mathematics, producing online courses and distance education. Universiteit van Amsterdam has a wide experience in using ICT supported courseware. Three JEM partners represent purely virtual universities deliver instruction exclusively online: FernUniversität Hagen, UNED National Distance University of Education, and the Universitat Oberta de Catalunya. Universidade de Lisboa, Buskerud University College, and Aristotle University of Thessaloniki are traditional higher education institution where the introduction of ICT support is taking place gradually.

Whilst all partners have specific dissemination channels, consisting of a network of students, or organizations or professional societies, the JEM network also includes the commercial publisher Liguori Editori and the major international academic society of professional mathematicians, the European Mathematical Society.

3. JEM Activities

The main vehicle for creating a new community of informed developers, users and authors of eContent in mathematics is the JEM web portal (1). It has been designed and setup as a collaborative website, incorporating several web 2.0 tools, where each registered member is free to contribute. The portal also acts as the official distributor of the deliverables and publications of the network. There are currently approximately 150 registered users. All registered users form the JEM community and are encouraged to post event announcements, news, but also release software or lecturing materials and share their academic blogs.
One of the major aims of the JEM portal pages is to distribute synoptic information concerning technologies, their usage and scenarios relevant for elearning mathematics. This information can be entered freely by the user community by adding new child pages to the wiki or by using specific templates for Software, tools and services, for Case Study, or for Learning Resources. These are successively linked to the proper sections in the wiki by the editors. The JEM web pages have been visited with an increasing trend as the network becomes more active and organizes more events thus also contributing to raising awareness on new and most popular technologies.

3.1. Standards

Concerning standardization activities, several JEM members are active within the W3CMath working group and the OpenMath Society. As a result of this synergy, a common resolution has been adopted during by these bodies aimed at ironing out differences and incompatibilities between MathML and OpenMath in their upcoming versions MathML3 and OpenMath3.
An encouraging sign showing the growing popularity of semantic markup is the adoption of OpenMath as exchange language among dynamic geometry systems, topic and goal of the newly funded eContentplus project Inter2Geo. Another new OpenMath based protocol for grid computing among computer algebra system, called SCSCP, has been developed by the SCIEnce, Symbolic Computation Infrastructure for Europe, project (2).

3.2. Events

The network has organized several events and, to date, archives approximately 100 publications, mostly slideshows. Video recordings are also available. The contributions to the first two JEM Workshops are collected in the proceedings (3).
Smaller workshops organized by the network include training sessions in using testing and assessment systems, envisioning seminars on the future of mathematical education and on emerging technologies (4), and meetings of special interest groups such as the one studying how to support Scientific Communities of Practice (4).
The network has also organized a mixed reality seminar, held synchronously in Helsinki and in the Second Life JEM office, in an effort to investigate virtual worlds

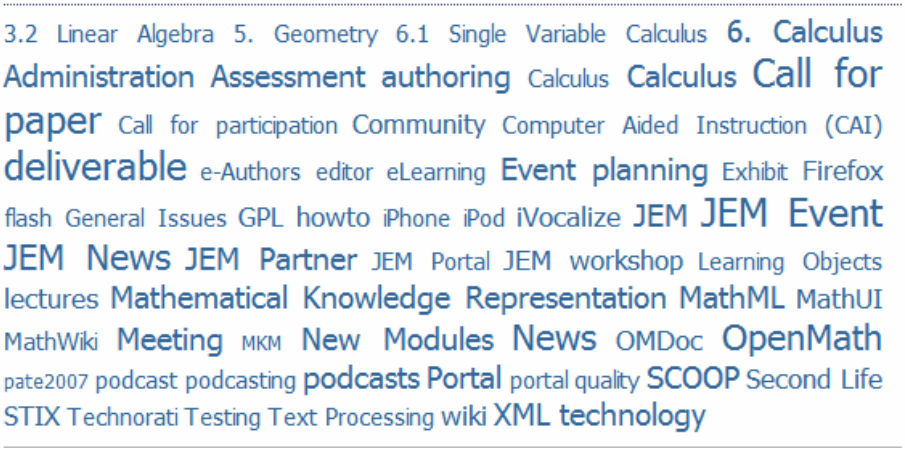

Figure 1: JEM folksonomy

as emerging educational platforms, with a special focus on their suitability for mathematics (6). The virtual JEM office in Second Life was setup as a permanent exhibition of the activities of the partners that could also be used for hosting online events and conference calls in a virtual world environment.

4. The JEM Portal

The main dissemination vehicle for the JEM Thematic Network is its web portal, designed as a collaborative social and professional network site. This section describes some of the features of the JEM web site.

Web 2.0

One of the trends that is typically marked as Web2.0 is the move towards user controlled data which is then remixed, transformed and harnessed as collective intelligence. Rather than having an authority that states what is acceptable, or desirable, in social networks, the members collectively decide what has value, and how to organize information. This translates to the creation of "folksonomies" in place of taxonomies, namely collections of tags that are used to describe the information shared by the users. User reviews, in place of expert or peer reviews, are another phenomenon that has replaced the more formal review processes used in the more traditional way of publishing. In case of the JEM professional network, the community assembles leading experts in technology for mathematics with experienced teachers and users of the electronic media for teaching. The folksonomy created by this community, and shown partially in Figure 1, describes exactly the topics, issues and problems faced when developing and using technology in mathematics education. Likewise, the volunteer-based approach to reviewing a

resource is carried out among peers and as such, is as valuable as the more traditional approach.

Members' Blogs and Profiles

Personal web pages are an outdated concept when one looks at the popularity of web sites such as Facebook, MySpace, and the more professionally oriented LinkedIn. On these web sites, users create their own space, or page, by assembling small applications that describe their interests. In the JEM portal, members have a limited way to create a profile page; yet, their personal page tells about their work and their contribution to the JEM community by collecting all items they have contributed to the portal. One example of contribution is a personal blog.

Users can publish a log of their daily activity by using the personal blog. Blogs have been used in education to collect the information of a course where the students can carry out a conversation on a posted topic by using comments. One of the advantages of blogs, besides making it very easy to publish one's own opinion, is that the information posted using a standard platform and tagged appropriately is discovered easily by search engines, for instance Google itself has a special blog search. In Web2.0, a blog is an authority when it is ranked high by web sites such as technorati.com that are indexing and tracking 112.8 million blogs and over 250 million pieces of tagged social media.

Since one of the goals of JEM is to enable conversations between developers and users, the mechanisms provided by blogs, with comments, tracking, and notification of changes for posts offer a very convenient platform that moves the discussions from the personal e-mail boxes to the open thus allowing for greater feedback without sacrificing in convenience.

RSS Feeds

The JEM portal makes use of RSS feeds both for publishing news and information collected from the partners' sites and for providing several channels to which interested parties may subscribe. Every tag describing any item posted on the JEM portal is associated with a feed one may subscribe to. As a registered member, one may also decide to receive e-mail notification of updates on types of content, on topic or taxonomy, and on events. Users of technology will find it convenient to subscribe and monitor the feed associated to Software and Services[2] which tracks new descriptions of software systems and services for education in mathematics. Teachers that are curious to know more about experiences of users of technologies may subscribe to the feed associated with the descriptions of Case Studies[3], which record challenges, lesson learned and publications on the introduction of technology in teaching mathematics. Finally, those who are ready to use electronic learning material

[2] http://www.jem-thematic.net/view/software/feed
[3] http://www.jem-thematic.net/view/casestudy/feed

can keep up-to date by reading the JEM repository feed[4] which publishes any new learning resource that is registered on the portal.
The JEM News Headlines offers a collection of news, from the portal itself but also aggregated by publishers that are especially relevant for the JEM community, acts as a screening service for its subscribers. RSS feeds, a Web 2.0 replacement for mailing lists and newsgroups, are not yet widely accepted and available. In our experience, only a small numbers of JEM partners is aware of RSS feeds published by their home institution or reads certain feeds on a regular basis, let alone provides a feed for his own news.

Wiki

The JEM network aims to distribute information and guidelines on the most useful technologies for electronic content in mathematics education. As this area is evolving daily and new software and tools emerge constantly, the information about them cannot be frozen in time. JEM has chosen the wiki framework to collaboratively and progressively develop community handbooks on authoring educational e-content in mathematics, developing e-technologies for mathematics and using e-content in mathematic/science education. JEM registered members may request authoring rights on the handbooks pages and can add or edit new sections in the specific areas of their interests. Examples of topics currently treated in the JEM handbooks range from e-learning quality issues, to descriptions of semantic encoding of mathematical information and of mathematics e-learning software.
The wiki section can grow only as a reflection of the interests of its users. While the framework is in place, it ultimately depends on the JEM members to take full advantage of it and to use it as a channel for dissemination of awareness.

5. eLearning Resources

Software and services, case studies and learning resources can be easily shared by the JEM community. A recent feature of the JEM portal is the facility to register learning resources together with metadata. The JEM repository enables easy cataloguing and sharing of learning objects among members of the JEM community. Fully integrated to the JEM portal as a Drupal module, the repository implements the LOM (Learning Object Metadata) specification of IMS (3) which defines a very rich set of metadata elements. The classification scheme for resources chosen for the JEM repository is the community developed LivingTaxonomy (4) specifically geared towards mathematics education. In addition, a set of keywords can be freely associated to the resources to add further hints for search. With proper metadata and classification, learning resources are easy to browse and search. Registration of a new learning resource is done by entering the metadata via an online form. Metadata records can be exported in xml conforming to the LOM specification.

[4] http://www.jem-thematic.net/lom/rss.xml

Registered resources can be scored and reviewed according to published Guidelines for Quality. The quality profile for the JEM network defines quality as relating to obtaining the best learning achievements. The JEM review process will try to evaluate the quality of resources, however it cannot assure the quality of the learning outcome or of the teaching based on such resources. JEM reviews aim to highlight resources that have been created by following sound pedagogical criteria and show proper use of technology. Currently, a Web 2.0 open reviewing approach, which has the benefit of including all stakeholders in the review process as is suitable for social networking, is in place for content posted as Learning Resource.
Future plans include the development of a federated search according to the Open Archive Initiative protocol for metadata harvesting which will collect the repository data from the OAI data providers such as the physics multimedia repository LiLi (9).

6. Concluding Remarks

The purpose of the JEM Thematic Network is to make mathematics education more efficient by proper use of technology. JEM does not develop new tools or software solutions but rather advances the proper use of existing tools, services and content. Once an educational organization starts using technology in education there is no turning back. Hence sustainability of the impact of JEM is automatic. JEM will facilitate the academic community to get proper information by organizing workshops, seminars, and, most importantly, by maintaining a web site containing information about technology, content, and services beneficial to eLearning in mathematics.

7. References

1. JEM -- Joining Educational Mathematics. *JEM -- Joining Educational Mathematics.* [Online] 2007. http://www.jem-thematic.net.

2. **Konovalov, Alexander, Linton, Steve and Roozemond, Dan.** *The OpenMath-based protocol for symbolic software composability.* Linz : JEM Thematic Network, July 25, 2007. JEM Workshop 2. http://www.cs.st-andrews.ac.uk/~alexk/papers/Linz2007.pdf.

3. **Verrijzer, Rikko and Spanbroek, Mark.** *1st Workshops Proceedings Annual Collection.* s.l. : JEM Thematic Network, 2007. Deliverable D3.4.1.

4. New and Emerging Technologies in Mathematics Education. *JEM seminar.* [Online] JEM Thematic Network, August 17, 2007. http://www.jem-thematic.net/seminar/netme.

5. JEM workshop on Scientific Communities of Practice. *JEM thematic network.* [Online] JEM, August 30, 2007. http://www.jem-thematic.net/seminar/scoop.

6. **Caprotti, Olga and Seppälä, Mika.** Mathematics Education in Second Life. *Sixth Open Classroom Conference on real learning in virtual worlds: Teacher Professional Development and the Role of Mentors and Avatars in Schooling 21C.*

[http://jem-thematic.net/system/files/EDEN_CaprottiSeppala.pdf]. Stockholm, Sweden : s.n., 2007.

7. **IMS Global Learning Consortium.** *Learning Resource Meta-data Specification.* [http://www.imsglobal.org/metadata/index.html]

8. Living Taxonomy. *Living taxonomy.* [Online] livingtaxonomy.org.

9. LiLi. *Die physicalische LinkListenDatenbank.* [Online] http://www.physik-multimedial.de/lili/golili/lili.php.

10. 3rd JEM Workshop Online Proceedings. *3rd JEM Workshop Online Proceedings.* [Online] February 1, 2008. http://www.jem-thematic.net/workshop3/proceedings.