WikiDIS: a case of collaborative content management system for educative community

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Abstract—**In this paper we describe a collaborative content management system based on Wiki Technology. This system, named WikiDIS, is designed to be used on a collaborative way by all persons who are part of an educational community (students, teachers, administrative staff, etc.) Functionalities of WikiDIS are friendly editing, editing and publishing workflows adapted to different types of users and communications facilities. The main functionalities and design aspects are explained in this work.**

Keywords-Wwb technology; Wiki technology; collaborative work; content management systems.

I. INTRODUCTION

Coinciding with the popularity of Internet, the Content Management Systems (CMS) has been developed during the last years. A CMS is a tool, that based on web technology, provides an environment where the creating, editing, managing of multimedia documents can be made on a friendly, reliable and secure way. These tools facilitate the tasks related to the web administration, offering functionalities such as: WYSIWYG editors, user communication (email, chats, forums, etc), resources for contents downloading and loading, web personalization and styles, language translation, etc. Nowadays there are multiple tools of this type that offers us these functionalities; one of them is the Wiki system that additionally has an important characteristic consisting in to permit the collaborative work of the users. A Wiki site is a collaborative web space where the user can create, edit and publish web contents on interactive, friendly and quickly way. With the Wiki technology, the contents of a Wiki site can be edited on a collaborative way using an Internet browser and a simple notation for contents formatting, indexing, etc. Additionally, this technology incorporates tools for versions controls of the contents permitting the pages restoration. The ideology of Wiki is democratic, it means that the contents changes in a Wiki site can be visible immediately but, generally, often there is a user who is responsible of verifying of the changes in order to permit only the publication of correct contents. The origin of Wiki is the community of the software designers [1], when the designers used shared information spaces in order to develop and discuss programming patterns. In 1995 Ward Cunningham created WikiWikiWeb, the first Wiki space, and he defined the Wiki of the following way "the simplest online database that could possibly work ". Later, in January 2001, the founders of the Nupedia project, Jimbo Wales and Larry Sanger, decided to use Wiki to develop the encyclopedia project, creating of this way Wikipedia the biggest Wiki space of the world. Initially, they used the Wiki tool called UseMod, but later they decided to develop a new Wiki tool that they called MediaWiki, being the base of many Wiki spaces nowadays.

In this paper we describe the functionalities and main aspects about the design of a collaborative content management system developed by us that we have called WikiDIS. This tool, based on Wiki technology and more specifically on MediaWiki, permits the editing and publishing of contents related to the activities of an educational and academic environment on a collaborative way. Specifically, WikiDIS has been developed to use by the community of the Department of Computer Science and Systems of the University of Las Palmas de Gran Canaria (DIS), in this context community means all the people which participate in an educational community, such as: pupils, teachers, administrative and services staff, academic authority, etc.

II. WIKI DISTRIBUTIONS

Multiple distributions of Wiki systems exist nowadays. These can be distinguished according to the type of organization they are designed, for example for personal or organizational use. Another classification can be established depending on the type of tools they have, for example version control of contents, security facilities, upload of different type of archives, etc. At last, another classification can be done depending on the technology used to develop the wiki distribution, for example:

- Java language has been used for Clearspace [2], JSPWiki [3], Kerika[4], Mindquarry [5] distributions.
- The technology .NET Framework has been used for FlexWiki [6], WWWiki [7] and ScrewTurn [8].
- The distributions Cliki [9] and SVNWiki [10] have been developed using LISP.
- Perl language for Twiki [11], UseModWiki [12] and WikiWikiWeb [13] distributions.

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- The Wiki systems TikiWiki [14], DekiWiki [15] and MediaWiki [16] are based on PHP technology.
- Phyton has been used to develop the MoinMoin [17], OghamWiki [18] and Trac [19].
- Instiki [20] and Ruwiki [21] have been developed using Ruby.

Some of these Wiki distributions are not free, specifically Clearspace, Kerika. Others are software under GPL or GNU license, for example JSPWiki, ScrewTurn, Twiki, SVNWiki, MediaWiki and TikiWiki or under license which permits the free use, for example Cliki (MIT license). From the point of view of the relevance of the Wiki site, we must cite UseMod, used to develop Wikipedia, Trac that is used by NASA's Jet Propulsion Laboratory and TikiWiki to develop collaborative workspaces in educative context, Aulawiki [22]. We have chosen MediaWiki because it has a very important property in order to incorporate new functionalities, this property consist of the development, installations and using of new software components named extensions. Additionally, MediaWiki has an organization very structured and configurable, supporting Latex to edit mathematic expressions and different language generators.

A reference of specific Wiki system for educational contexts is the Aulawiki, having as the more important functionality the support of collaborative workspaces named Tiki Workspaces. In these systems, two main roles are defined: pupils and teachers; existing others roles: registered associated to all the registered users, anonymous for not registered users and owner to represent the owner of a workspace.The participants of a workspace can be organized in groups to work in different subjects. Additionally, the available resources in each workspace can be configured between a set of tools such as: Blog, Wiki page, file gallery, etc.

III. GOALS AND REQUIREMENTS OF WIKIDIS

The main objective of WikiDIS project is to implements a collaborative content management system, based on free software, which permits to automate the documents flow generated in an educational university organization. The collaborative requirement means that the system must permit to all the people who integrate the educational community can produce, a controlled way, the contents for the information system of organization. Therefore, the system must to have a friendly user interfaces that permits to the users the creation, edition and publishing of contents regardless of the level of technical knowledge of the user.

Conceptually, we have identified three main entities in an educational organization:

- Participants that are: pupils, teachers and administrative and services staff. In the case of the DIS, the numbers of member of each category are 1200 pupils, 120 teachers and 2 administrative and service staff.
- Academic government that is formed by directive staff and commissions; in the DIS the directive staff is formed by the following figures: director, secretary and laboratory chief, existing 2 permanent commissions that are the academic commission and the economic commission.
- Academic demand configured by the academic qualifications and the subjects of their curriculums. The DIS develops its activity in 103 subjects organized in 13 curriculums of academic qualifications.

The contents are generated as consequences of realizing of tasks by the members belong to the categories of participants and academic governments. These tasks can be grouped in the following sets or categories:

- To coordinate and developing of the subjects teaching and learning. All the participants of the educational community execute tasks belong to this categories; pupils in tasks of learning, teachers in tasks of teaching and people belong to academic government and administrative staff in tasks of coordination of the teaching and learning activity.
- To elaborate the teaching project of each subject. This set of tasks are executed by participants belonging to the entities of teachers, academic government and administrative and services staff.
- To organize, coordinate and promote the activities related to research, technological development and innovation. The executors of this category of tasks are the same as reported in the previous category.
- To promote and developing the educational innovation. Like the first set of tasks, people belonging to all the type of participant entities can execute tasks belonging to this category.
- Management of the material, economic and personal resources assigned to the DIS. Basically, this set of tasks is executed by participants belonging to the entities of academic government and administrative and services staff.
- To elaborate, updating and publishing the internal regulations of the DIS. People belonging to the entities of academic government and administrative and services staff are the executors of this set of tasks.
- To develop and maintain the information system of the DIS. The participants are the same as the previous category.

In order to access to the different contents associated to these tasks, depending of its category, each participant have a set of functionalities and privileges. The main challenges of the WikiDIS project were:

- To improve the organization of contents of the Wiki system, that is lineal based on the concept of paper, in order to support more complex structures of contents required in an educational organizations, being frequent hierarchical organization of contents. To meet this challenge, we have introduced two new concepts named subject and prefix to organize the contents, now the contents are organized in subjects and the

subjects are structured in papers. To allow sharing papers between subjects, we use the concept of prefix of the following way: each subject and paper has a set of prefixes associated; a paper is shared by all the subjects that have at least one common prefix. Thus, we can say that conceptually the contents in our model are structured as a undirected graph where the nodes represent subjects and paper and the arcs represent the relationship "to have a common prefix", having each arc a name that matches the prefix name that represents.

- To reconcile the democratic principle for the collaborative use of the contents Wiki Systems with the controlled and collaborative access to the contents required in an educational environment. Specifically, in Wiki systems the contents are organized in papers, each paper has a administrator user who decides if others users have the privilege to modify the paper. In an educational environment, the contents are structured in different subjects and each subject has at least one administrator who decides, between the users that can access, the type of privilege of each of them.

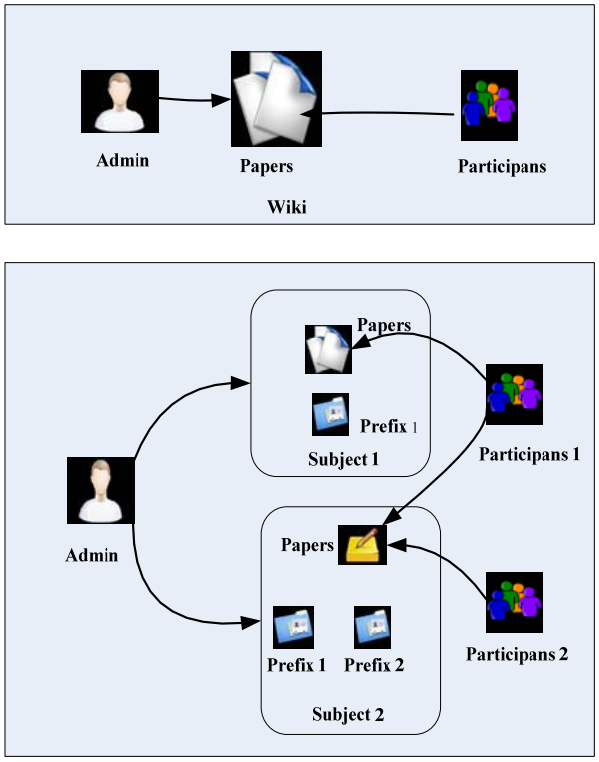

Figure 1. Wiki organization versus WikiDIS organization

IV. System Description

WikiDIS is a evolution of the software tool called MediaWiki (GPL license software) for this reason WikiDIS has functionalities such as: friendly editing of the web contents, using WYSIWG editor, building and publishing workflows adapted to the different users profiles, tools to translate for different languages (about 100), control of versions and control of expired contents. Moreover, it incorporates resources for user communication (email, chat, forums) and tools for loading and unloading of multimedia contents.

In WikiDIS all the elements that participate in the educational and academic activities are represented by entities, these entities are structured in three categories: people (pupils, teachers, administrative staff, etc.), academic management (directive staff, academic council, commissions, etc.) and subjects. The entities have different types of privileges for editing, publishing and visualizing of contents depending on the activity performed, for example: organizing, coordinating and controlling of the subjects teaching, resources management related to the educational and academic activities, building, updating and publishing of documents (manuals, procedures, teaching projects, regulations, etc.). Additionally, WikiDIS supports the contents management related to the teaching and learning tasks of the subjects realized by pupils and teachers.

To achieve all the design goals, we have developed and integrated new modules in the MediaWiki architecture, specifically in the named logical level and data level. In the logical level, new PHP scripts and extensions have been added in order to incorporate new contents and functionalities to the database, for example the content management required by subjects and groups of them . Moreover, several files have been modified to support the characteristics of the workflows of the academic and educational tasks. In the data level of MediaWiki, we have modified the design of the database by the incorporation new tables and fields. As a result WikiDIS has the same structure of MediaWik that is a layered structure [23], but its architecture is different because it incorporates new components and functionalities, for example new sections named prefixes, subjects and chat, are available in WikiDIS . For these reasons, we can affirm that WikiDIS is an evolution of MediaWiki; this evolution is specifically oriented to the educational environment.

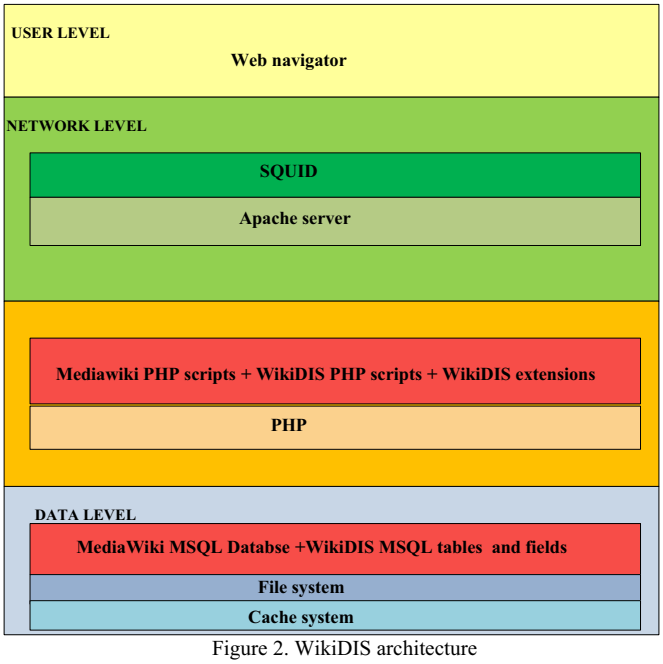

Figure 2. WikiDIS architecture

Following, the new modules developed for WikiDIS will be described. To build these components, we have used a set of development tools, specifically HMTL, PHP, JAVASCRIPT and AJAX for elements based on web technology and MSQL as database tool.

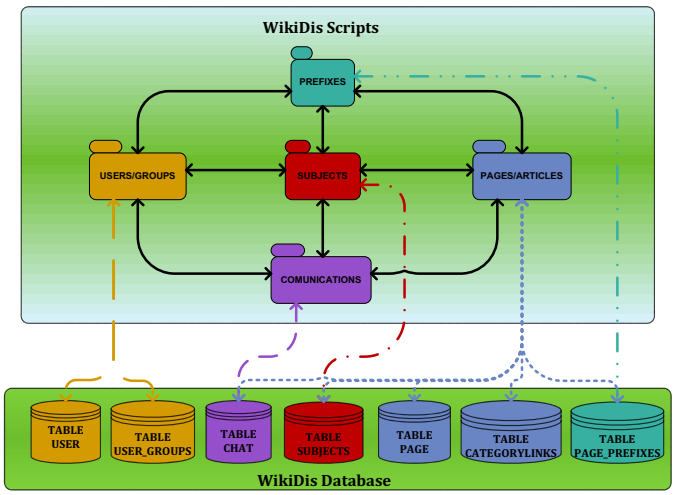

Figure 3. Relations between scripts and data in WikiDis

A. *Users and groups module*

This module manages the users of the system, here the registers of the users are performed, and the interaction with existing prefixes and grouping in different set of users called groups, being also the management of these groups responsibility of this module. As consequence of these functionalities, the users can be related to groups, subjects and to set to them the privileges of use of the system. Additionally to the two groups defined initially in MediaWiki, WikiDIS has three main groups defined initially: pupils, teachers and administrative and service staff. To set these three groups in WikiDIS initially and to garantee that these cannot be modified, we have introduced the specification of these new initial groups in the file named DefaultSettings.php, although in the specifications of MediaWiki the modifications of this file is not recommended. To permit the automatic creation of user from CVS format file, another modification has been made in MediaWiki, it consist in to develop a new extension based on the existing extension named Import Users created by Rouslan Zenetl y Yuriy Ilkiv [24]. By this new functionality we can set the users of the system (pupils, teachers and administrative and service staff) automatically from electronic document coming of the educative administration. Another new extension, named User Administration, has been developed to facilitate the management of the personal data of the users and the groups and subject related with them. To administrate the groups of the system, a new script has been developed, named Groups Administration and based on the existing extension Prefix Security created by Borut Tomažin [25], using this new extension the administrators of the system, they can create prefixes sets, for example related with subjects, with different privileges for different users and groups . Finally, in order to have additional information about users, new attributes are incorporated in the user registers of the database as well as their methods of insertion in the database.

B. *Prefixes module*

This module supports the controlling access of the different pages of the system. WikiDIS incorporates a new prefix named "Prefix Administration" which is based on the "Prefix Security" of MediaWiki mentioned in the previous point. Using this WikiDIS module, we can specify different type of access to the pages, for different users and groups, incorporating a contents management controlling based on user, pages of themes (for example subjects) and prefixes which permits the prefix administration (creating, modifying and erasing of prefixes) and the setting of relationship between prefixes and users . To achieve these functionalities WikiDIS incorporate a new file named "PageRestrictionHooks.ph" by this module, when a user tries to access a page, the system verifies if the user has the proper privilege of access , informing to the user in case of access denied. Figure 3 show us the relationship between this module and the rest main modules of WikiDIS. This figure shows us how the prefix manager is related with the user manager to control the users and prefixes groups. In the figure we can see how each subject has at least a specific prefix, of this way the access control can be achieved. The relationship between pages and prefixes is set indirectly; by the access privileges of all pages that have titles with some prefix declared in the system as restricted prefix. . Finally, also the database is used by this module, specifically the file PageRestrictionsHook and the table page_prefixes, to control the privileges of the users specified in the prefixes.

C. *Subject module*

A main entity of WikiDIs is the entity subject because all the contents associated with the learning and teaching process are organized around this entity, for example all the subjects of the academic qualifications have an instance of this type. This module is responsible of the management of all the instances of this entity, an extension named Subject Administration that has been developed to do this task. Additionally, a new class, named subject, has been necessary to implement in MediaWiki and like other new modules of MediaWiki it is based on the existing of another component of MediaWiki, specifically the class named user. The class subject has the following attributes:

- mId to represent a unique identification of the subject instance.
- mName: this is the symbolic name of the subject instance.
- mPrefixSubject: this is the prefix of the subject, using this attribute the control access to all the pages related with this instance of subject is achieved
- mKnowledgearea: it identifies the knowledge area of the instance subject. The Knowledge area is an administrative concept, used in the Spanish university teaching system. By the use of this term we can relate subjects belonging to the same administrative area.
- mShift to indicate the teaching timetable of the instance subject.
- mDescription: that is a description of the instance.

- mWebPage specifies a set of web sites related with the subject represented by the instance
- mReadPermissionTeachers controls the read privilege of the teachers, using the prefixes manager.
- mEditPermissionTeachers controls the modification privileges of the teachers, using the prefixes manager.
- mReadPermissionStudents controls the read privileges of the pupils, using the prefixes manager.
- mEditPermissionStudents controls the modification privilege of the pupils, using the prefixes manager.

Aditionally, associated with this subject class, a set of methods have been developed. These are:

- For creating and loading of instances of subjects: load, loadFromId, loadDefaults, loadFromDatabase, newFromName, clearInstanceCache, createNew, addToDatabase, saveSettings, createSubjectPageInitial, createSubjectCategory. By this set of methods, we can create and load the instances of the subject class, storing the data fields in the database.
- For editing the attributes of the instances: getCanonicalName, getID, setID, getName, setName, getGroupPermissions, getGroupName, getGroupMember, getAllGroups, getImplicitGroups, getGroupPage, getPrefixSubject, setPrefixSubject, getKnowledgeArea, setKnowledgeArea, getShift, setShift, getDescription, setDescription, getTitulation, setTitulation, getWebPage, setWebPage. . By this set of methods, we can obtain and modify the instances attributes of the subject class. The methods get to obtain and the methods set to modify the attributes.

The figure 3 shows us the relationships of the subject manager with other managers of WikiDIS. As we can see in the figure, to relate users, teachers and groups of them with subjects, this module is connected with the user manager. Also, the connection between this module and the communication module is represent in the figure, by this relationship WikiDIS provides a new functionality consist of virtual tutorials of teachers and pupil accessible in each page of a subject by a new section named communication section. To end the explanation of this module, we must to say that each subject has a set of pages and papers related by categories, these categories are set when the subject is created therefore there are two entities to control the pages of the subjects that are the prefix and the category. To facilitate the management of subject pages, WikiDIS incorporates a mechanism that every time that a subject is created a main page of the subject is incorporated automatically to the system and providing pages templates based on text formats of Wiki also.

D. Communication module

As in the cases of the above modules and in order to support the facilities of chat and virtual tutorial, WikiDIS has a new tool named Chat Action Hook based on the existing chat tool named Chatty developed in PHP by Marco Olivo [26]. Each page or paper belonging to a subject has a tab, using this resource the user can access to this resource. By this tool the users, related by a common subject, who have the proper privileges can communicate on a spontaneously way. The relationships between this module and other WikiDIS modules are illustrated in the figure 3. The relationship between this module and the user module is made to validate that the user has the proper privileges to participate in the chat and tutorial and to authenticate the chat messages. The relationship between this module and the pages module is established in order to register information about the pages for which the communication between users. Nowadays only the communications made in the last 24 hours is stored in the system.

E. Pages and papers module

This module is responsible of the creation and edition of pages and papers. To implement the conceptual organization of the contents around to the subjects and to speed the access to the pages, WikiDIS use the concept of category to organize the pages of the system. WikiDIS incorporates two existing extension named Require Category and Manage Categories created by Hendrik Brummermann [27] and Florian Mayrhuber [28] respectively. The first extension is used to guarantee that each pages belong at least one category and the second is used to facilitated the categorization of the papers, consisting this extension in three parts: a section to visualize all the existing categories of the system, a section to create new categories and finally a section to visualize the categories of the paper. This organization of the pages permits to the system collets papers that have some common aspect. The figure 3 show us that this module is connected with all the previous modules, the reasons of these connections have been explained previously. Finally we must comment that the connection of the manager of pages and papers with the database is made to manage properly all the information and to carry out all the cheeks of pages and papers, using the following database tables: page, subjects, chat, categorylinks and page prefixes.

F. Other developed components

Additionally to the modules modified or created previously explained, WikiDIS has a set of new modules in order to achieve specific functionalities of WikiDIS. These modules are:

- Main pages module: In a Wiki site the main page of the site is common for any use that access to the site. In WikiDIS when a user tries to access to the system, this module checks if the user is a system registered user. If the user is not registered in the system, then a common main page is showed for the not registered user. Otherwise, the system shows to the user the main page associated of the main category that user belongs. In the system there are three main categories of users (pupils, teachers and administrative and service staff). This module of main pages management is based on the extension named Group Portal created by Tim Laqua [29]. Additionally, this module checks if the user has administration privileges in order to provide specific administration options to the main page.

Figure 4. Initial page of WikiDIS

- User interface: In order to achieve a simple, usable, attractive and intuitive user interface we have developed a new interface based on other existing of MediaWiki named MonoBook and Modern. The first was selected because of its intuitive aspect and the second because of its attractive aspect and it is more readable for the user. A result of this new interface is the new skin for WikiDIS.

V. WIKIDIS IN ACTION

The execution of WikiDIS is illustrated in this section. To use WikiDIS, the first step consist of the user authentication, the figure 4 shows how to introduce the user name and the passwordDepending on the role of the user authenticated an initial page is presented. Te figure 5 illustrates this page for a user with the role of administrator or teacher. For all the kind of user, WikiDIS provides options for content management and preferences, additionally administration of entities (users, group of users, prefixes and subjects) are provided for the case of users with the role of administrator or teacher. This distinction of roles between users is an important difference compared to other wiki distributions where basically the roles are administrator, editor and reader.

The initial page for administrators and teachers has six sections, these are:

- My subjects: using this section the teacher can manage the subjects related with him. If teacher is not related with any subject, then this section does not appear.
- Other managements: using it, the user can access to some miscellanea functionalities, such as: search, files upload, my contributions, special pages, etc.
- User management: all the functionalities related to the users can be accessed by this section.
- Subject management: this section permits to access to all the functionalities related with subject admin.
- Group and prefixes management: using this section the users with role of teacher or administrator can manage the groups and prefixes.
- Profiles: using this section the user can manage his profiles and preferences to use the applications.

If the user has the role of pupil, then the initial page only will have the sections: My subjects, other managements and profiles.

Figure 5. Mainl page for adminsitartor or teacher

To facilitate the entities management WikiDIS provides a set of facilities. For example, in the figure 6 the page to create a user is illustrated, by this page the common fields for any user are introduced.

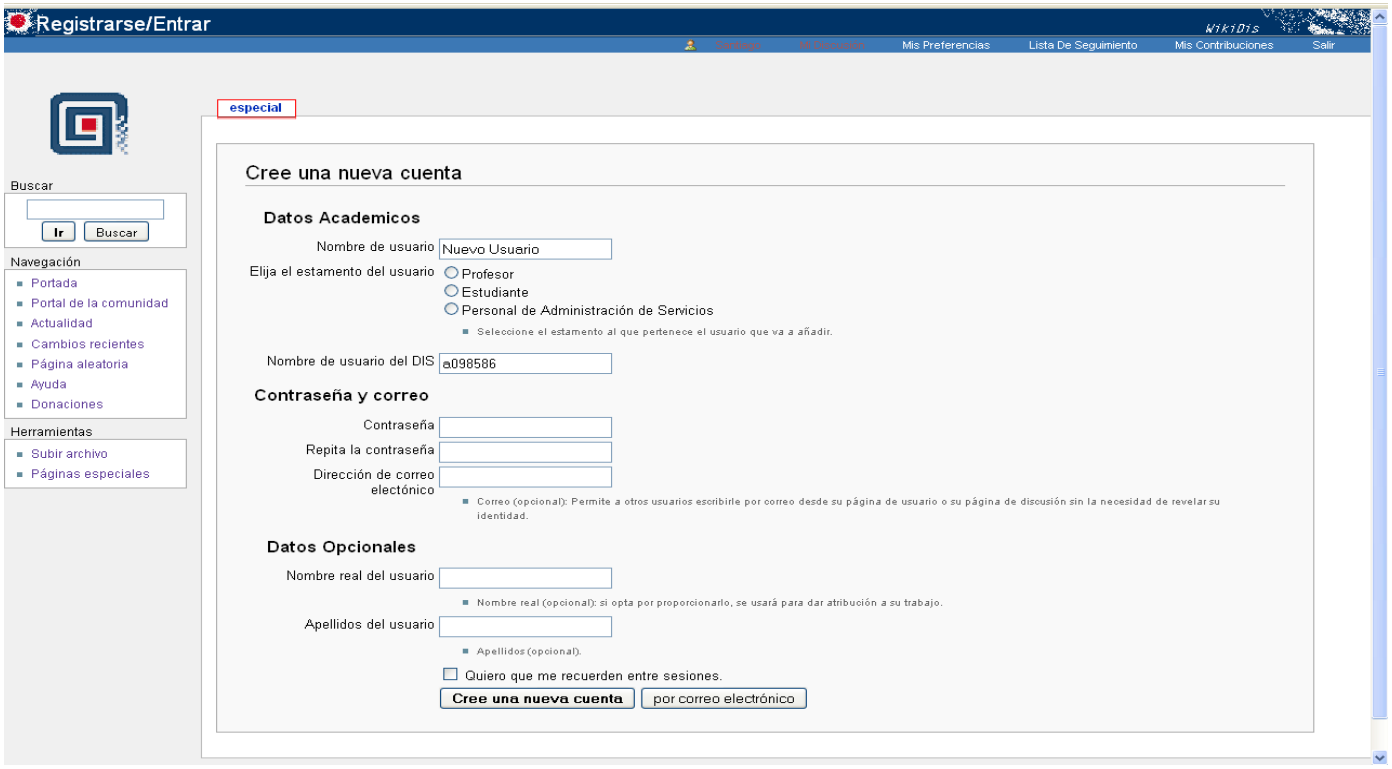

Figure 6. Page for seeting the common atributes of a new user

Depending on the role of the new user, specific pages are presented to complete the setting of attributes of the new user.

The figure 7 presents the specific page for a new user with the role of pupil.

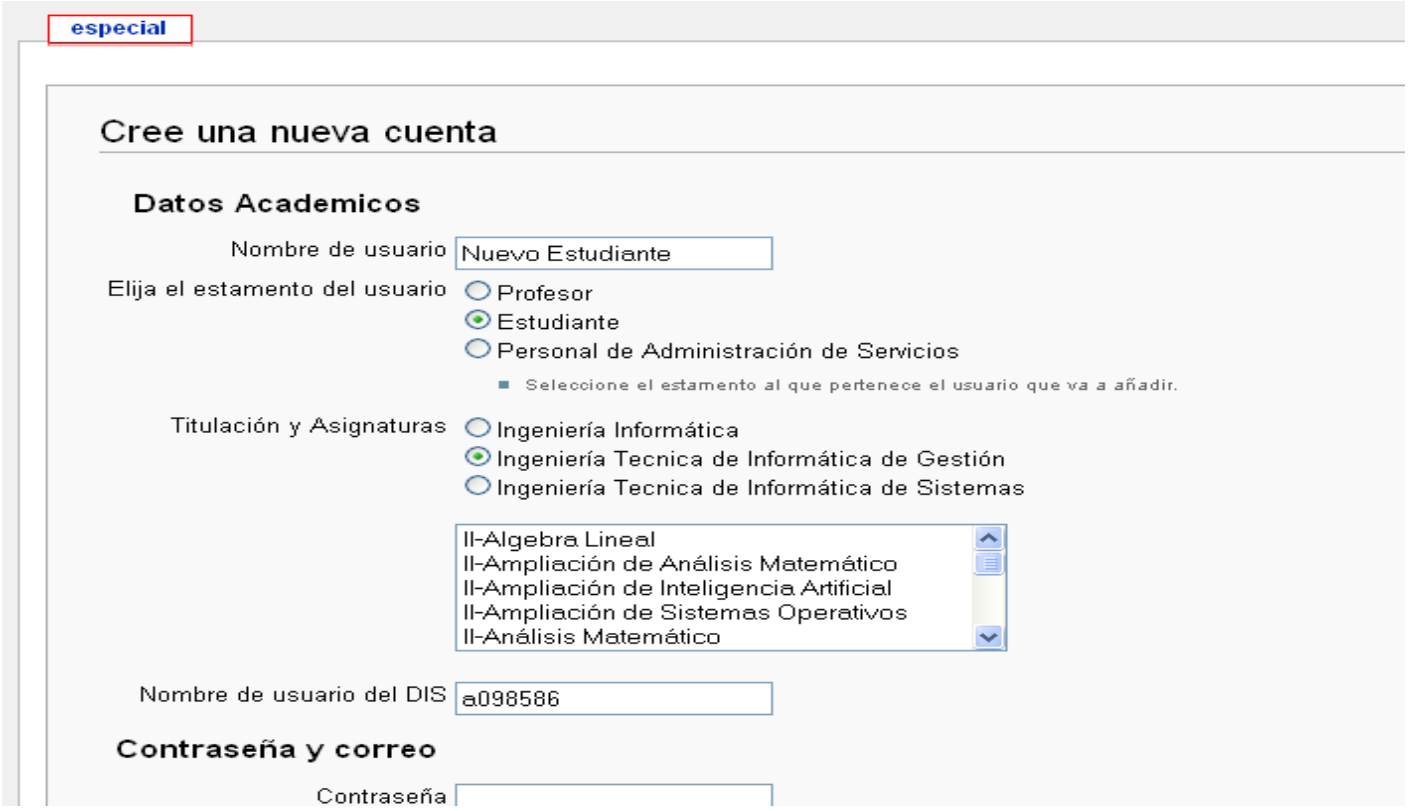

Figure 7. Page for seeting the specific atributes of a pupil

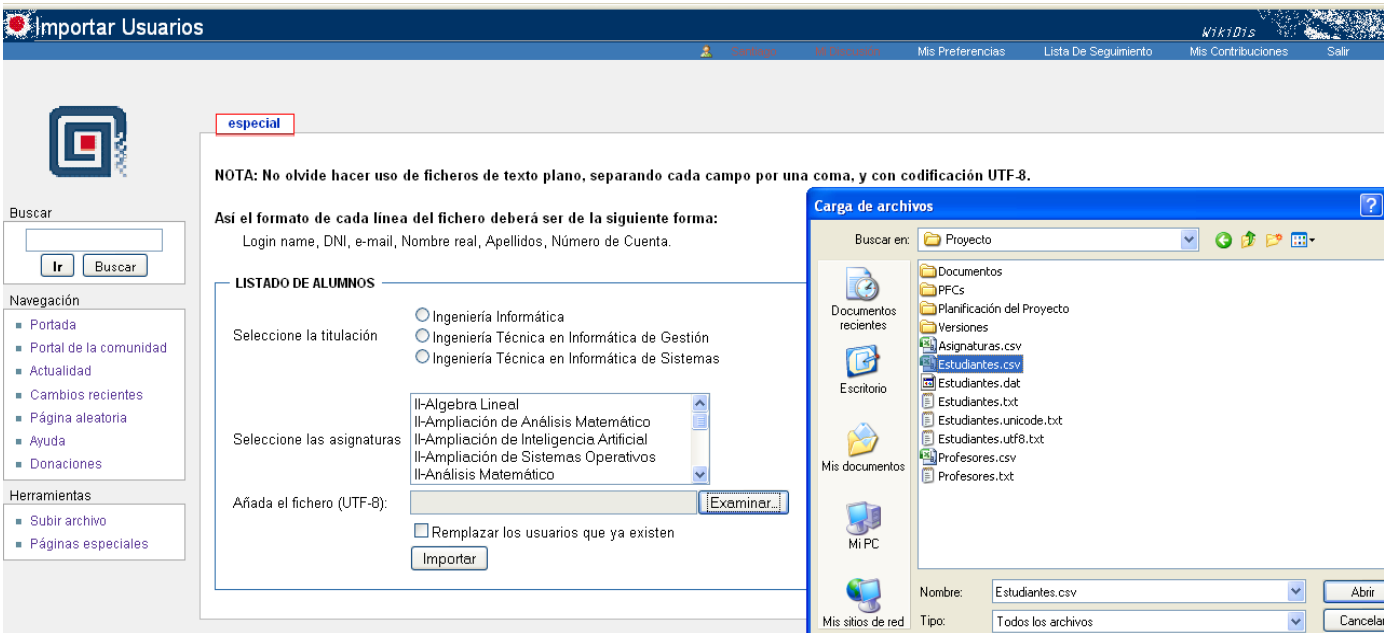

Figure 8. Page to create automatically users by the users import facility

To create a set of users on automatic way, WikiDIS provides a facility to import users. In the figure 7 the page to use this functionality is presented.

Additionally others facilities for entities management are provides by WikiDIS, specifically for the management of users groups, prefixes and subjects. For example, the management of the subjects is achieved by two main pages. The first page is showed in the figure 9, in this page all the subjects that can be accessed by the user are presented.

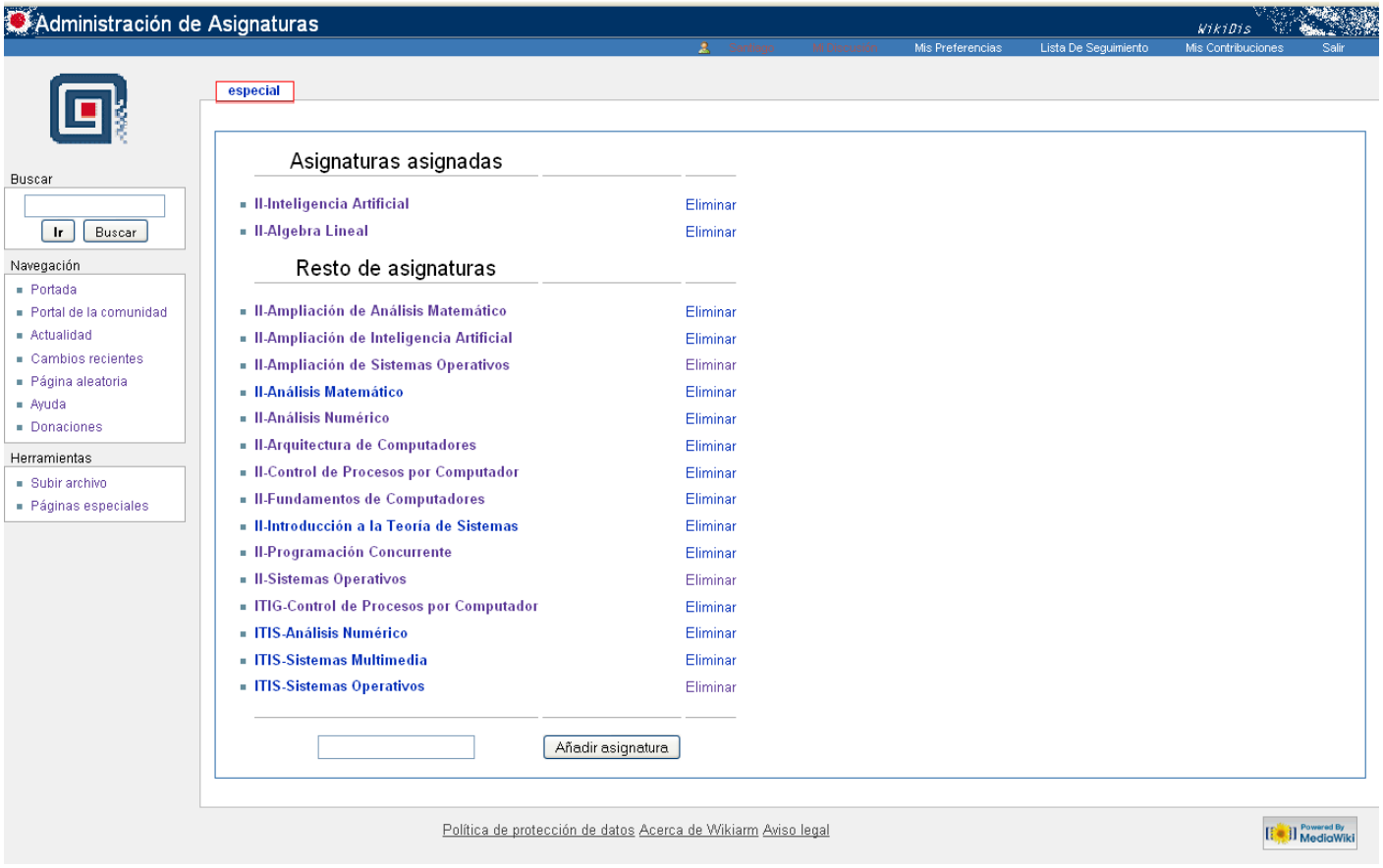

Figure 9. Page to access to the subjects management

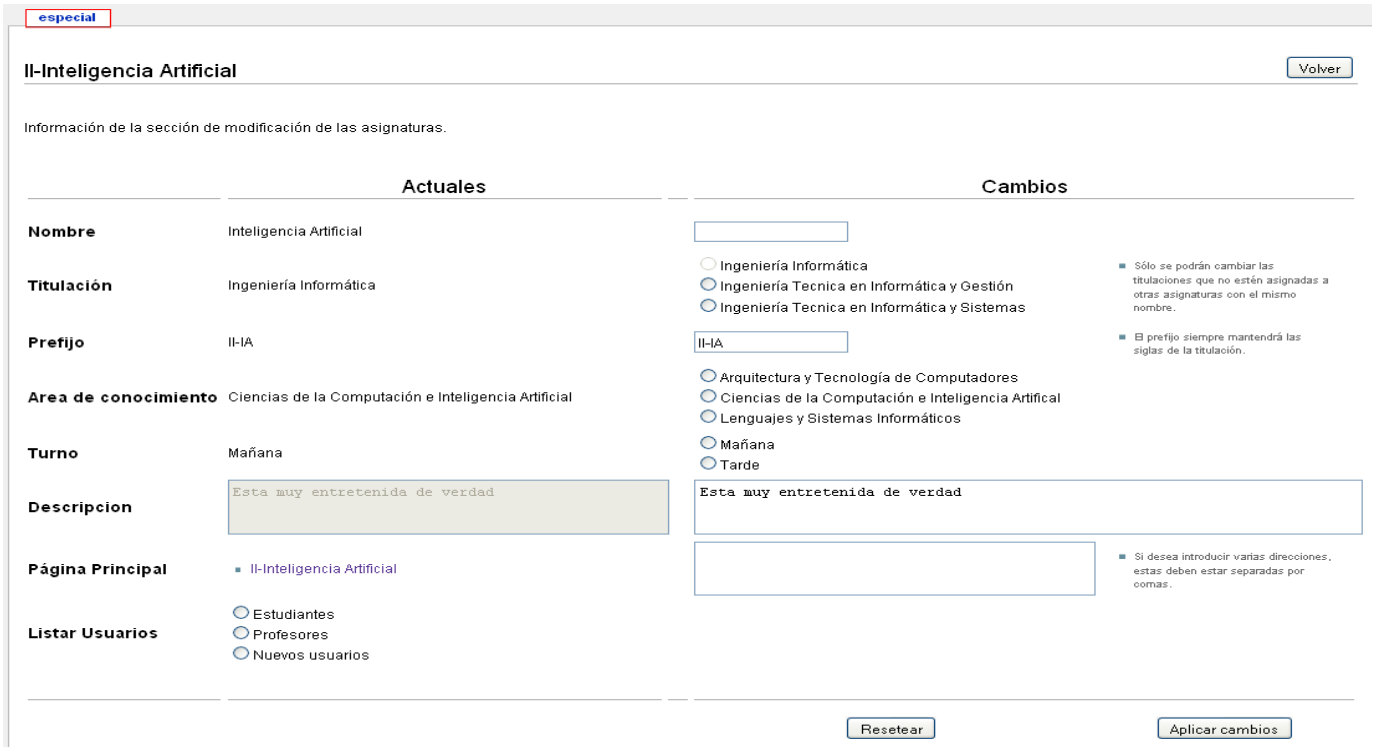

Figure 10. Page for setting the specific atributes of a subject

Selecting one of these subjects, then the second page is showed. Figure 10 illustrates this page; all the subject attributes can be accessed by this page.

This organization of content based on prefixes, subjects and articles is another significant difference of WikiDIS with respect to common distributions of wiki. In these distributions the content organization of a subject is carried through papers, so that content associated with a subject can be seen as a two-level tree where leaf nodes are papers. The content organization of WikiDIS is based on the concepts of prefix, subject and paper allows a more flexible structure, where the papers can be part of different subjects, that is sharing content, leading to a content organization as a graph

Finally, the WikiDIS communication module is illustrated. This module permits the chatting between users that can access to a specific paper. The figure 11 presents the chat page.

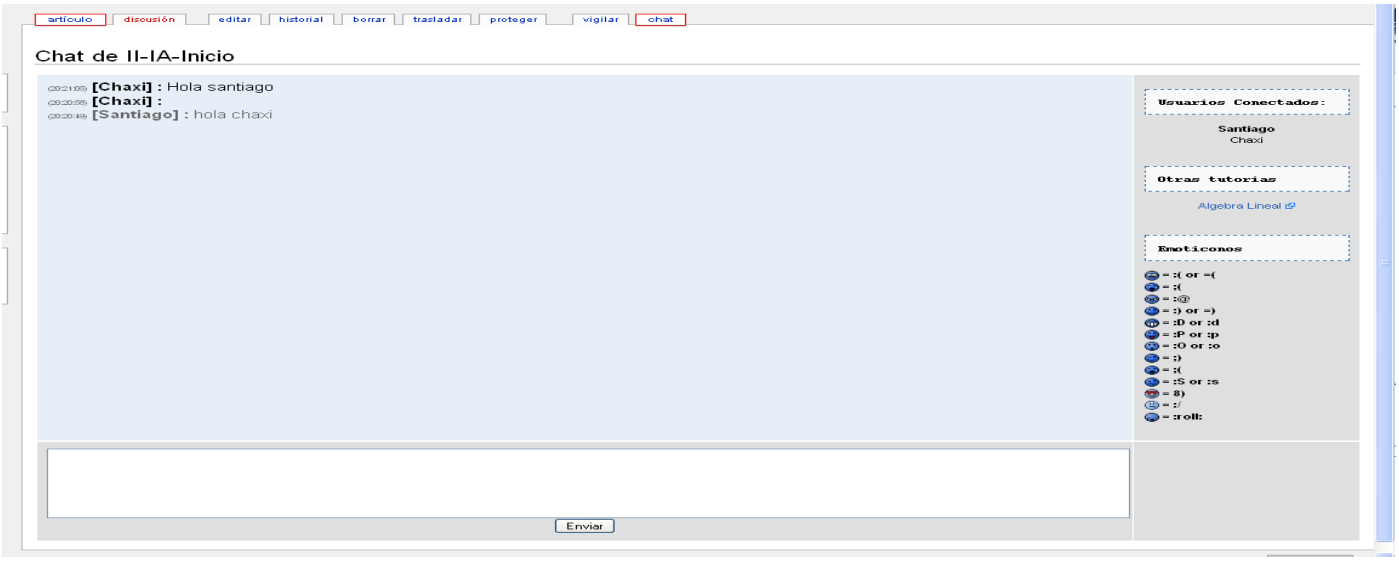

Figure 11. Page for chating about a paper

VI. CONCLUSIONS AND FUTURE WORKS

In this paper a collaborative contents manager system named WikiDIS has been presented, this system an evolution of the Wiki technology tool named MediaWiki. We can affirm as a main conclusion of the WikiDIS project that is possible to develop a collaborative contents manager system for a university educational organization based on Wiki technology. This system is able to support the controlled production and access to the contents associated to the work flow executed by all the participants of a university educational community. Although nowadays WikiDIS has been used in a university context, this system could be used in other educative contexts. Because WikiDIS is based on MediaWiki, WikiDIS has all the functionalities and advantages of the Wiki systems. One of these advantages consists of the possibility of adding new components and functionalities. In a general educative context and as future work, our group will try to integrate to WikiDIS in other very popular educative telematics platforms like Moodle. In the specific context of the computing science, a next goal to achieve is to incorporate resources to support collaborative and concurrent processes for learning and teaching in subject such as development of programs in different programming languages.

REFERENCES

[1] Wiki. Available: *http://es.wikipedia.org/wiki/Wiki*

[2] Clearspace. Available: *http://es.wikipedia.org/wiki/Clearspace*

[3] JSPWIKI. Available*: http://www.jspwiki.org/*

[4] Kerika. Available: *http://www.kerika.com/*

[5] Mindquarry. Available: *http://en.wikipedia.org/wiki/Mindquarry*

[6] Flexwiki. Avalable: *http://sourceforge.net/projects/flexwiki/*

[7] WWWiki. Available: *http://wwwiki.wikispaces.com/*

[8] Screwturn. Available: *http://www.screwturn.eu/*

[9] Cliki. Available: *http://www.cliki.net/index*

[10] Svnwiki. Available: *http://en.wikipedia.org/wiki/Svnwiki*

[11] Twiki. Available: *http://twiki.org/*

[12] Usemod. Available: *http://www.usemod.com/cgi-bin/wiki.pl*

[13] WikiWikiWeb. Available: *http://en.wikipedia.org/wiki/WikiWikiWeb*

[14] Tikiwiki. Available: *http://info.tikiwiki.org/tiki-index.php*

[15] Mindtouch. Available: http://www.mindtouch.com/

[16] MediaWiki. Available: *http://www.mediawiki.org/wiki/MediaWiki/es*

[17] The MoinMoin Wiki Engine. Available: *http://moinmo.in/*

[18] Ogham. Available: http://ogham.odonnell.nu/

[19] Trac. Available: *http://trac.edgewall.org/*

[20] Instiki. Available: *http://www.instiki.org/show/HomePage*

[21] Ruwiki. Available: *http://rubyforge.org/projects/ruwiki/*

[22] Tiki for education. Available: *http://edu.tikiwiki.org/*

[23] MediaWiki Architecture. Available: *http://meta.wikimedia.org/wiki/Help:MediaWiki_architecture*

[24] Extension ImportUser. Available: *http://www.mediawiki.org/wiki/Extension:ImportUsers*

[25] Extension Prefix Security. Available: *http://www.mediawiki.org/wiki/Extension:Prefix_Security*

[26] Chatty a PHP Chat Script. Available: *http://olivo.net/software/chatty/*

[27] Extension RequireCategory. Available: *http://www.MediaWiki.org/wiki/Extension:RequireCategory*

[28] Extension ManageCategories. Available: *http://www.MediaWiki.org/wiki/Extension:ManageCategories*

[29] Extension GroupPortal. Available: *http://www.MediaWiki.org/wiki/Extension:GroupPortal*