SECTION 3:
Adaptive Collaborative Course Generation

In order to satisfy the goals stated in section 1, we have implemented a mechanism for the dynamic generation of adaptive collaborative web-based courses. This mechanism integrates adaptation methods and techniques and collaboration capabilities for the personalization of the course contents, navigational options and collaboration aspects. It consists not only of putting adaptive courses and collaborative tools together, but also of integrating adaptation and collaboration in a seamless way. In order to support collaborative activities and the adaptation of different aspects of the collaboration processes, new modules have been incorporated to the TANGOW system [Carro01].

In this section, details about the goals of the proposal, as well as the way of including collaborative activities in TANGOW and the mechanism for the automatic generation of adaptive collaborative web-based courses, are presented.

3.1. Specific goals

The main goal of our proposal concerns the generation of web-based courses that include not only contents and exercises to be done individually, but also collaborative activities adapted, at runtime, to the students.

In this approach, the courses are composed of activities to be performed by the students. These activities concern the study of theoretical explanations, the observation of examples, the realization of individual exercises or the accomplishment of collaborative activities. A collaborative activity has been defined as "a task to check the comprehension of specific topics, to put into practice the knowledge acquired related to particular subjects, or to develop personal and social skills, that is performed collaboratively". A collaborative activity will be constituted by a problem statement and a set of tools to support the cooperation among the students.

These web-based courses can be adapted to each user on the fly, by selecting, at runtime, the activities available to each student, the navigational guidance and the multimedia contents to appear in the course pages. As far as collaboration is concerned, the adaptation focuses on the presence/absence of collaborative activities, the specific collaborative activities to be proposed, the time at which they are available, the specific problems to be solved, the most suitable partners for a student to cooperate with (dynamically group formation) and the collaborative tools to support the group

collaboration [Carro03b] [Martín03a] [Martín03b]. The adaptation is based on information about the student's features, preferences, opinions and behaviour while interacting with the course. This information constitutes the user model (which will be described in 3.2.). More details about the specific aims of this work are presented next.

The **presence or absence of individual and collaborative activities** could depend on the user model. For example, a teacher might consider suitable to include a collaborative activity about a certain subject to be proposed only to students without previous knowledge about the subject. This collaborative task would be used to facilitate and check the comprehension of the theme. However, the teacher might consider that the students with previous knowledge about the subject do not need to go deep into it and they will be not presented with the task. Another example about the aim of this adaptation capability is the possibility of presenting specific review tasks only to the students that have not been able to assimilate a concept. In this case, the activity would be presented once the students have accomplished the activities related to the concept.

The **navigation guidance** provided can also be adapted to each student. It can be useful to modify the flexibility of this guidance according to the student needs and preferences. Therefore, the guidance would be more direct for some students (for instance, those with sequential learning style, who usually prefer to access to the information sequentially), whereas it would turn out to be more effective to give more freedom to other students, so that they can access to the topics as they prefer or even glance at them as a whole (for example, students with global learning style, who usually prefer to have a global vision about the subjects before studying in depth each concept). Different types of navigational guidance can be specified for every set of activities, without being necessary to use the same one for the whole course. Apart from that, it is also possible to offer different alternatives to learn the same topics, using different didactic methods or classifications to explain them. In this case, the students can choose among the available options or even visit all of them. For example, it could be considered as useful to propose a collaborative activity to students with sequential learning style (who prefer to learn step by step) only after they have accomplished others tasks in strict order, whereas it can be better to offer the whole set of activities to students with global learning style, so that they can perform the collaborative task whenever they desire. Or, for instance, it is possible to guide novice students more directly, by offering them small sets of available tasks at each step with predetermined orders of execution, and to give more freedom to advance students, who would have a wider set of available activities without order-of-execution requirements.

Moreover, a teacher might want to specify the need to carry out a specific task or set of tasks before accomplishing others. These tasks constitute the **requirements** for an activity or group activities to be accomplished. It could make sense to establish some requirements only for certain students and to omit them for other students depending on their features and behaviour. Therefore, the requirements would be applied either to specific groups of students or to all of them. For example, it would be useful to have the

possibility of setting a requirement so that a collaborative activity would be proposed to novice students only after they have performed other particular activity (which can be at any point of the course), while advanced students would be able to accomplish the collaborative task without specific requirements.

When students are ready to accomplish a collaborative task, it could be useful to **group them automatically** according to their characteristics (stored in the user model), taking into consideration their opinions about previous collaboration experiences too. This would be especially useful because of the adaptive nature of these learning environments, in which each student learns at his own pace, so that the most advanced or quickest students do not need to wait too long for pre-established partners who are not ready to start accomplishing the collaborative tasks yet.

Concerning the page generation, the **multimedia contents** (content fragments with multimedia elements) can be adapted to offer intelligible and appropriate explanations, examples and exercises to each student. Therefore, it is necessary to provide different versions of the same contents, so that the most suitable ones can be selected at runtime to compose the pages before being presented. To support this selection, it is necessary to add meta-information to the content fragments. Some aspects to be considered are the vocabulary used to explain the subjects in an understandable way, the language in which the contents are written or the difficulty of different (individual or collaborative) exercises related to the same topic. Concerning the last one, it could be desired to propose a collaborative activity related with a specific subject to all the students, in such a way that the specific **collaborative-problem statement** to be proposed to each group can be different, even related to the same subject. The problem to be proposed would be selected depending on the group knowledge about the subject and, of course, on the difficulty of the available problem statements. For example, it would be possible to propose a collaborative activity with a more complex problem statement to advanced students, and to propose a similar -but simpler- one to novice students. To support this adaptation it is necessary to provide several content fragments with the problem statements and the information about their difficulty.

Each group of students would perform collaborative activities in **collaborative workspaces**, which should include, at least, the problem statement and a set of tools to support the collaboration. Therefore, it would also be possible and convenient to adapt the set of **collaboration tools** depending on the group features. Students with visual learning style usually prefer working with graphical resources, and those with textual learning style usually prefer textual sources and interfaces. Therefore, it would be useful to provide the most comfortable interface and tools to each type of students so that they can perform the activity better. Of course, the interface may depend on the nature of the activity to be accomplished but, if this is not the case, it is possible to adapt it according to the group features and preferences. For example, to support a collaborative task execution, it may be suitable to provide the visual-learning-style students with a graphical editor and a forum,

whereas it might be better to replace the graphical editor by a textual editor for textual-learning-style students. Furthermore, it can also be useful to enable the access to synchronous tools when at least two students of the same group are connected at the same time.

All these aspects (presence or absence of collaborative activities, navigation guidance, requirements for the accomplishment of collaborative activities, multimedia contents and problem statements, collaboration tools and group formation) will be decided by considering the user model. Our goal is to support all these adaptation capabilities for each group of students, providing collaborative activities to the users in appropiate points of the course and generating the most suitable collaboration workspaces depending on the student's personal features and learning process. The way in which it has been done is explained in the next subsection.

3.2. Including collaborative activities in TANGOW

The first task to be performed for the inclusion of collaborative activities in TANGOW is to specify the student's features to be used with adaptation purposes, which set up the **user model**. In our approach, the user model can be constituted by the following:

- Personal features: age, language, previous knowledge, learning style (sequential/global, visual/verbal, intuitive/deductive, active/pasive)…
- Preferences: detailed/general information, theory-before-practise versus practise-before-theory.
- Achievements: activities already performed, knowledge acquired (exercises done correctly/incorrectly)
- Behaviour: time spent carrying out an activity, active/passive attitude, contributions to the collaborative activity.
- Opinions about previous collaborative experiences: partners that use to collaborate versus passive partners, partners that facilitate the communication versus difficult-to-communicate partners, and so on.
- Any other feature consider as relevant

The teacher or the course developer can specify the features that will compose the user model, as well as their possible values (discrete or ranges of values).

Once the user model has been stated, the course components, as well as their adaptation capabilities, have to be specified. The specification of adaptive collaborative systems, either separated or integrated, is not a simple task. As the number of components and adaptation capabilities increases, the complexity of their description rises exponentially. We have extended the formalism used in TANGOW [Carro01] to support the

representation of adaptive collaborative courses in which collaborative activities are seamlessly integrated within the courses and, moreover, adapted to the users, giving rise to dynamically generated personalized courses [Carro03a].

3.2.1 Rule-based course structure representation

The course structure is represented by means of teaching tasks and teaching rules [Carro01], which support the inclusion of collaborative activities, as well as the adaptation of their presence/absence, the navigational guidance offered and the requirements to perform them. These adaptation possibilities, described in 3.1, depend on one or more characteristics of the student user model, and should be specified during the course description.

The use of a single set of tasks and rules supports the creation of different courses for different students without specifying a new course structure for each variation desired. Two examples of rule-based structure descriptions are shown next.

Condition	Composed Task	Subtasks	Sequence
Novice	Course	T1, T2, T3, C1	AND
Advanced	Course	T2, T3, C1	ANY
Passive	T4	T5, T6	AND
Active	T4	T5, T6, C2, T7	ANY
T2	T8	T9, C3	OR
-	T10	T11, C4, T12	AND

Table 1. Example of rule-based structure description

In the example shown in table 1, the collaborative task C1 is available to novice students only after they have performed tasks T1, T2 and T3 (AND sequence), whereas it is available to advanced students at any time (ANY sequence). Note that, for the later, it is not necessary to perform task T1. While performing task T4, the collaborative task C2 will be proposed only to the students with active learning style, who can perform the individual tasks T5, T6, T7 and the collaborative activity C2 in the order they prefer (ANY sequence). The collaborative task C2 will not be proposed to those with passive learning style, who will neither be presented with task T7 and will have to perform T5 and T6 in strict order (AND sequence). In order to perform task T8, all the students must perform task T2 before (rule activation condition). When this condition is satisfied, the students can accomplish one or both of the next activities: individual task T9 or collaborative task C3 (OR sequence). Finally, task T10 will be available to every user, and all of them must perform all subtasks in the order they appear in the rule (AND sequence) to complete the task T10. In this case, collaboration (task C4) will be proposed to all of them after performing task T11 and before task T12.

In the example shown in table 2, part of the rule-based description of a course on Civic Education is presented. At a certain point of this course, task DemoGov (Democracy as Government) will be presented to novice and advanced students. When a novice student is ready to perform it, the system presents the next four subtasks: Intr (introduction), ManinGov (goverment as Manin), PolRep (political representation) and CDemo (collaborative activity related with these previous concepts). These subtasks will be presented one after the other (AND sequence). For advanced students, the system will present different subtasks depending on the type of information preferred by the student (general/detailed). If the student prefers to obtain general information, the collaborative task CDemo will not be presented, since it is probable that the student is only interested in acquiring global information about the course contents. However, the advanced learners who prefer detailed information will be presented with the collaborative activity CDemo. Finally, all the advanced learners will be able to accomplish the subtasks in the order they prefer (ANY sequence), regardless the type of information desired.

Condition	Composed Task	Subtasks	Sequence
Novice	DemoGov	Intr, ManinGov, PolRep, CDemo	AND
Advanced, Detailed	DemoGov	ManinGov, PolRep, CDemo	ANY
Advanced, General	DemoGov	ManinGov, PolRep	ANY

Table 2. Other example of Rule-based description

According to table 2, it seems that the collaborative activity CDemo is the same for all the students. However, although it is related to the same topic (CDemo represents a collaborative activity about the democracy in the government), different problem statements and different collaborative tools can be offered to each type of student, as it is explained next.

3.2.2 Collaborative-Workspace representation

In our approach, a collaborative workspace is composed by a problem statement and a set of collaborative tools. While the students are performing a collaborative task, they interact thought a workspace. The main interface of this workspace contains the main collaboration tools, and additional tools are accessible from it. These tools can be either selected from a pool of existing tools or provided by the course developers, and can be different for each collaborative task and/or group of students.

With the aim of providing the most comfortable workspace for each group while performing each collaborative task, collaborative-workspace and collaborative-tool rules have been created. These rules support the workspace adaptation. The specific collaborative workspaces will be dynamically generated for each group and each task at runtime. Activation conditions in these rules indicate the requirements for a collaborative

workspace to be generated. These conditions can be related to any feature, preference, achievement or behaviour stored in the user model.

The example shown in tables 3 and 4 illustrates the use of these rules. As it is shown in table 3, the problem statement to appear in the workspace for novice students (StCDemoA) will be different than that for advanced students (StCDemoB). A priori, the collaborative tools will be the same (ToolsA). In addition, different conditions can be specified in the collaborative-workspaces rules, which represent the requirements for the collaborative activity to be performed. Rule 2 indicates that the workspace for the collaborative task CDemo will be generated for advanced students by joining StCDemoB statement with the corresponding tools once they have performed task ManinGov, whereas it will be generated for novice students by selecting StCDemoA statement without any additional requirement.

(rule)	Condition	Collaborative Task	Statement	Tools
(1)	Novice	CDemo	StCDemoA	ToolsA
(2)	Advanced, ManinGov	CDemo	StCDemoB	ToolsA

Table 3. Collaborative-Workspaces Rules for a collaborative activity

Therefore, although the collaborative activity identifier is the same a priori, the problem to be solved is different. Regarding the collaborative tools used for the problem resolution, both types of students use the sets of tools identified by ToolsA. But the meaning of ToolsA can be different for different types of students, as it is explained next.

As it has been stated before, a collaborative workspace is composed by a problem statement and a set of collaborative tools (main tools and additional tools). The way they are combined in a specific workspace is described by collaborative-tool rules. The course developers does not need to implement or provide them, since existing tools, based in PHProjekt [http_ref04] and the Corona server [http_ref05], are available to support the collaboration between students. Therefore, it is possible to choose among these tools or to add new specific collaborative tools, if they are needed to accomplish particular tasks.

In the example proposed in table 4, rule 1 describes ToolsA as the set of main tools MainH1 and the set of additional tools AddH1. The tools to appear in both the main and the additional interface depend on the student's learning style. The main tools for students with visual learning style (rule 2), will be a graphical editor and a chat, while in the set of main tools for students with textual learning style (rule 3) the graphical editor is replaced by a text editor. Regarding the additional tools, visual students will be able to access to a text editor, email and file sharing tools (rule 4), while textual students will have access to email and file sharing tools (rule 5). The whole set of tools (ToolsA) has been associated with the collaborative task CDemo (see table 3). Therefore, the mentioned tools will be combined to create the collaborative workspace for the students to perform this task. ToolsA could

have been associated to any other collaborative task since, for every task, the corresponding rules are triggered at runtime for the generation of the specific workspace.

(rule)	Condition	Tools	Subtools
(1)	-	ToolsA	MainH1, AddH1
(2)	Visual	MainH1	GraphEd, Chat
(3)	Textual	MainH1	TxtEd, Chat
(4)	Visual	AddH1	TxtEd, Email, Fileshare
(5)	Textual	AddH1	Email, Fileshare

Table 4. Collaborative-Tool Rules

The use of collaborative-tool rules allows the description of:

- Sets of tools to be used by default in the course.
- Specific sets of tools for particular collaborative tasks. These sets of tools can be the same for all the students or can differ depending on the students' features and achievements.
- Specific sets of tools to be offered to different types of students. They can be used in every collaborative task or limited to certain tasks.

During the course execution, when a group of students is ready to perform a collaborative task, collaborative-workspace and collaborative-tool rules are triggered in order to generate the specific workspaces to support the collaboration between the students of each group.

3.3. A mechanism for dynamic generation of adaptive collaborative Web-based courses

Once the course components have been described, the course itself is dynamically generated for each student by selecting, at every step, the most appropriate course components (activities to perform, problems to be solved, contents, collaborative tools, partners for each student, etc) depending on the information stored in the user model.

When students are ready to accomplish a collaborative activity, the system groups them automatically, taking into consideration the information stored in the user model. As it has been stated by different researchers (see section 2), the optimal size of a collaborative work group is the minimum possible one. Therefore, a possible optimal default size for each group in our system would be three people, because in a two-person group it could be the case that a member of the group leaves the course or shows a passive attitude, leading to a situation in which the other student works alone. For this reason, we have set the default size for each group to three, although each teacher can specify, during the creation

phase, a different value for particular activities, sets of activities, or even for the whole course.

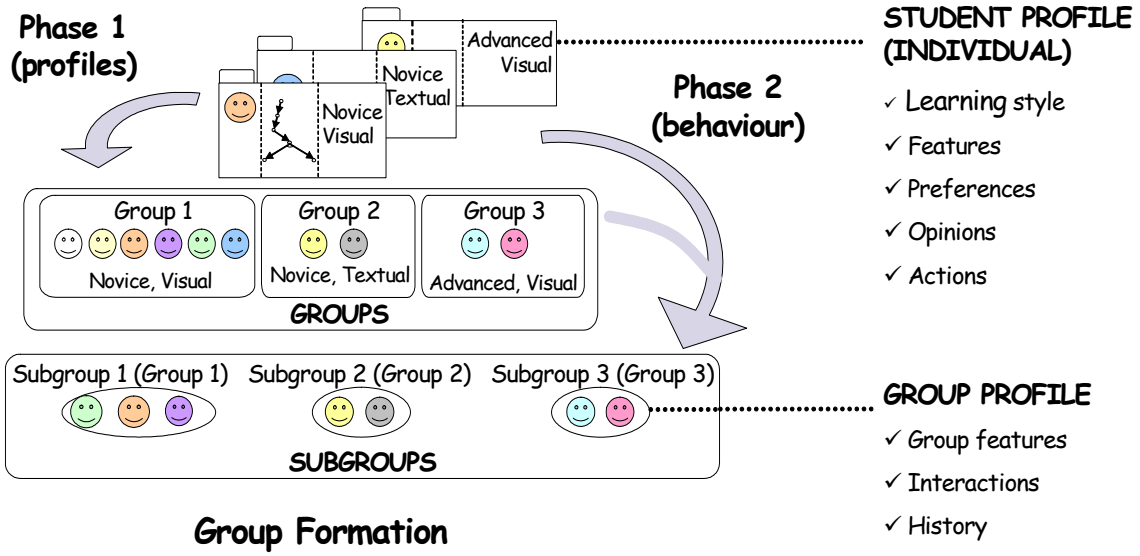

Figure 1. Automatic Group Formation

Group formation is done in two phases. In the first one, the system groups the students depending on their profile (phase 1 in Fig.1), according to the default criteria (similar students will be grouped together) or to the teacher's criteria (mixing novice and advanced users, mixing active with passive ones, and so on).

In a second stage (phase2 in Fig. 1), for each collaboration task, as soon as it is available (that is, its prerequisites are satisfied) to more than one user belonging to the same group, subgroups start to be formed, so that the students can initiate the activity as soon as possible. During this phase, the system takes into account the size specified for establishing the groups to perform this activity, the students' behaviour while interacting with the course and their opinions based on previous collaboration experiences (i.e., other users who they do not wish to interact with again, after a bad experience). As it will be further explained in the conclusions, future experiments with real students in different contexts will help us to find the best possible criteria for group formation in these contexts.

The whole process for automatically course creation is presented in 3.3.1, and some examples of the execution of a course on Civic Education are explained in 3.3.2.

3.3.1 The Mechanism

When a student starts taking a course, the course-structure rule conditions are evaluated in order to select the rule that describes the decomposition of the main task of the course whose activation conditions are satisfied by the student. The rule is triggered

and, depending on the rule sequencing mode and the subtask prerequisites (if any), all the subtasks, only some of them, or a single task, are made available to the student. During the course execution, the most suitable tasks for the student to perform are selected in a similar way at every step, by taking into account the course-structure rules and the student's features, previous achievements, opinions in previous collaborative activities and student preferences (see ① in Fig.2) [Carro03b].

The next step concerns the generation of the page to be presented to the student. Depending on the number of available tasks, the student is presented with a selection menu or with a page of contents. In the first case, the menu is built starting from the task descriptions. In the second case, if the task is not collaborative, the system selects, among the set of fragment variants associated to the task, the most suitable content fragments to build the page. This selection is done by comparing the student's features with the ones each variant is intended for. In addition, an annotated table of contents is generated, so that the students can know which tasks are (not) available at each time and which ones they have already performed. A progress bar and a button bar are also generated. If a common pattern has been provided, it is used to generate the page (② in Fig.2).

When a student is ready to perform a collaborative activity, the system checks if the student can collaborate with other students, and creates the groups and subgroups for this collaborative activity. When a subgroup is ready to perform a collaborative task, the corresponding students are informed (the link to this collaborative activity is activated). The collaborative workspace is build at run time as soon as one of the students clicks on the corresponding link. Firstly, the collaborative-workspace rules that describe the potential workspaces to support the execution of the task are evaluated. The rule whose activation conditions are satisfied by the students in the subgroup is triggered, and the most suitable problem statement and set of tools for the subgroup are selected. Secondly, the collaborative-tool rules are evaluated and the corresponding one is triggered to get information about the specific collaborative tools (both main tools as additional tools) that will be used to support the students working on the task and also about their layout [Martín03a] [Martín03b].

Finally, the page is built by joining the problem statement, the set of tools described above, the access to the additional tools and other supplementary tools, such as a buddy list in an integrated interface (④ in Fig.2). In figure 3, the collaborative workspace generated for the collaborative task CDemo of the Civic Education Course is presented. The collaborative workspace showed is generated to support the execution of the collaborative task CDemo by advanced students with visual learning style who want to receive detailed information. For these students, the workspace is built starting from the problem statement StCDemoB (rule 2 in table 3) and the set of tools ToolsA, which corresponds to a graphical editor and a chat in the main interface (rule 2 in table 4), and a text editor, e-mail and file sharing tool as additional tools (rule 4 in table 4).

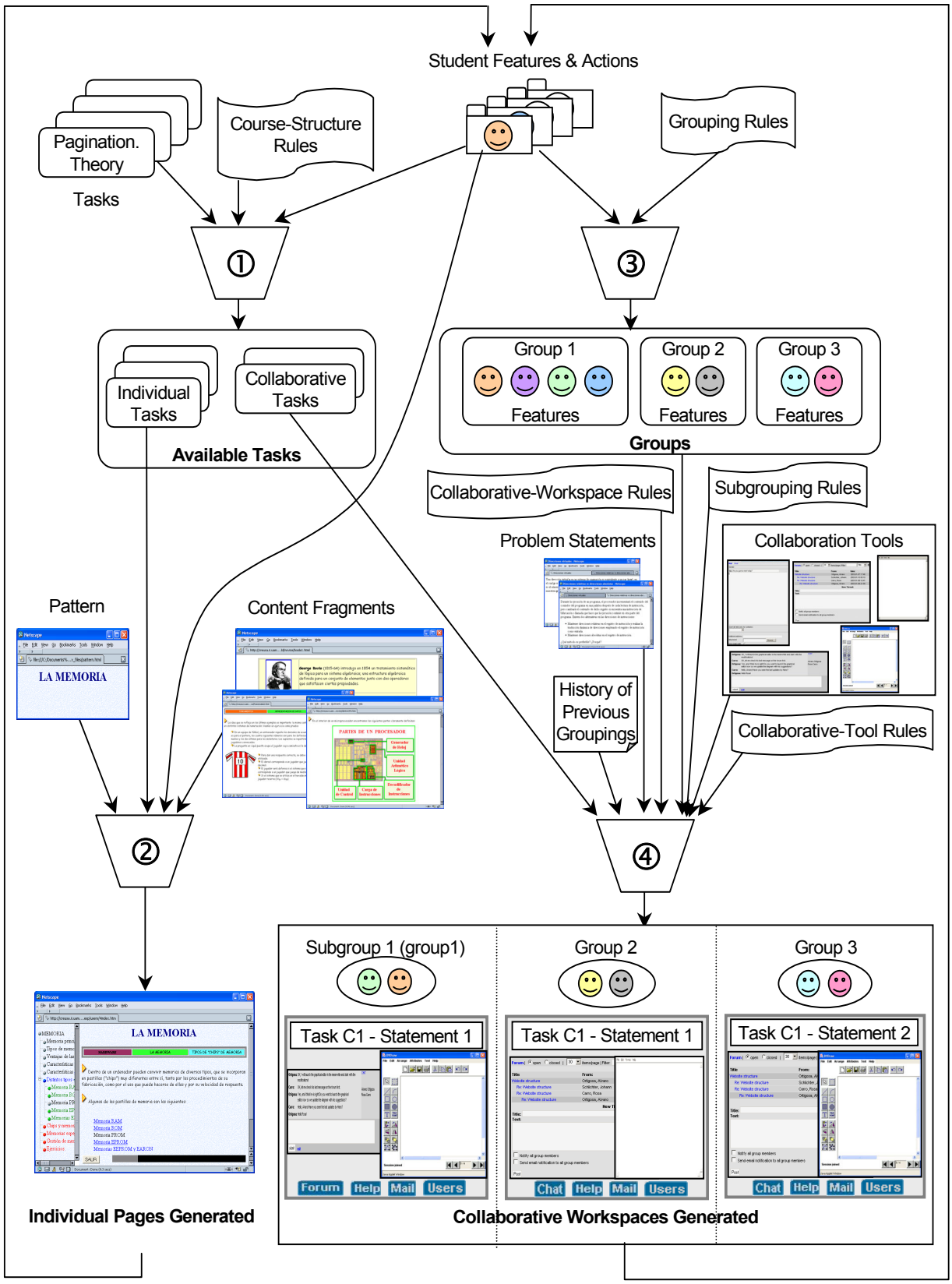

Figure 2. Dynamic Generation of Adaptive Collaborative Courses. ©LNCS 2806 2003

Furthermore, students have information about their group identifier and the presence/absence of their partners at every time. Finally, the workspace contains three additional flaps:

- Main tools: This option will be used for the learners when they have clicked on any other tab, to go back to the main-tool interface for this collaborative activity.
- Send the solution: This flap is used to send the result of the collaborative activity to the system. This result will be suitable of being evaluated automatically or checked manually by the teacher, depending on the nature of collaborative activity.
- Disconnect: The student can exit the collaboration workspace by clicking on this flap.

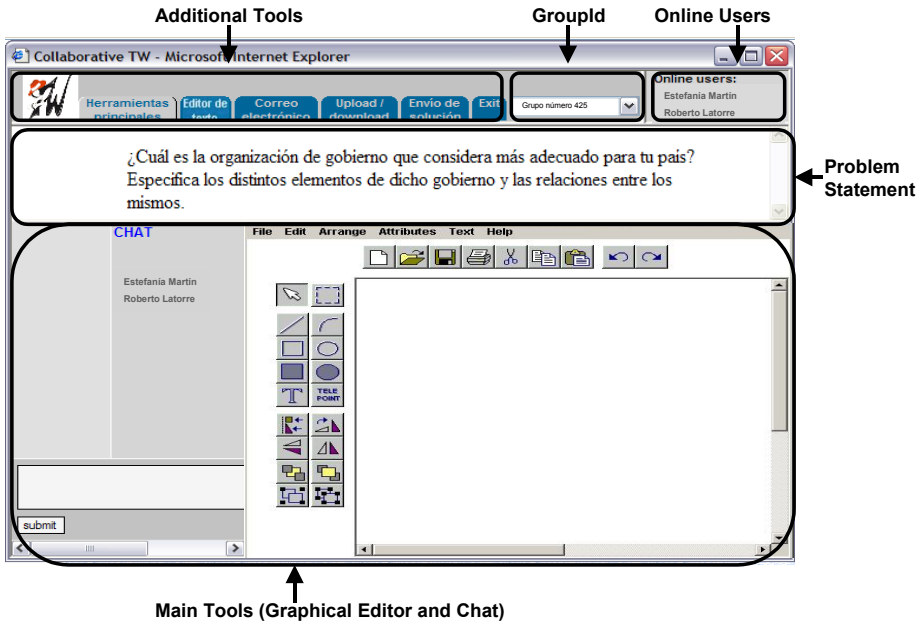

Figure 3. Dynamic Collaborative Workspace

When several students of the same group are interacting at the same time, the access to synchronous tools is enabled. When only one of them is connected, this access is disabled. The students of each work subgroup can organize themselves for the task execution: they can divide the task and provide partial solutions, discuss and join them in a complete one; they can solve the problem altogether; or they can provide complete independent solutions to be discussed until they agree the best one.

Furthermore, while the students are accomplishing a collaborative activity, the teacher, by means of monitoring tools, might detect which groups have stopped the activity execution or which ones are in the way of obtaining a wrong solution. He might offer help, explaining or indicating the concepts related to the activity, offering clues for the students to obtain a good solution, motivating the students or even joining subgroups of work that have the same problems, so that they can share their ideas.

All the student's actions while they are interacting with the course (pages visited, exercises done, exercises correctly solved, etc.) are stored, so that these data can be used with adaptation purposes during the course execution and also for the evaluation of results. All these actions (both individual aspects like individual exercises done and results and collaborative aspects like common solution, reasoning process, opinions about the collaborative activity) can affect the remaining course evolution (presence or absence of collaborative tasks, group formation, complementary review activities, and so on).

3.3.2 Examples of execution

A few examples of execution of six students with previous knowledge (advanced learners) and six students without previous knowledge (novice learners) of the Civic Education course (see table 2) are given next. Figures 4 and 5 are related to the execution of different subtasks of the composed activity DemoGov (Democracy as Government) by advanced learners. These figures show the activities presented to the students, taking into account their user model (in this case, information about the previous knowledge and the type of information desired). In both figures, the order of subtask execution is indicated by the arrow.

Figure 4 illustrates the execution of the tasks by three advanced students with visual learning style, who prefer to access to general information. As it was described in table 2, this type of students only have to perform the subtasks 'PolRep' and 'ManinGov' to complete the composed activity 'DemoGov'. They do not accomplish the collaborative activity CDemo. As it can be seen in this figure, student 1 and student 3 chose to perform the task 'PolRep' before the task 'ManinGov'. However, student 2 decided to accomplish these subtasks in reverse order.

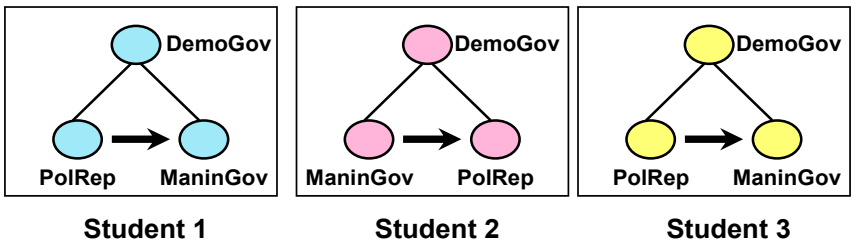

Figure 4. Execution of advanced students with general information

Other three advanced students selected 'detailed information' when they started the course. The execution of the composed task 'Demogov' is described in figure 5. This type of students can accomplish the three subtasks (PolRep, ManinGov, CDemo) in the order they desire. The condition to perform the collaborative activity CDemo is to accomplish the task 'ManinGov' (prerequisite of task CDemo) first. Student 4 performed the collaborative activity in the last place. Student 5 took a similar decision, although this one

accomplished 'PolRep' after 'ManinGov'. The last student, student 6, did the collaborative activity right after 'ManinGov', which was the only prerequisite (see table 3).

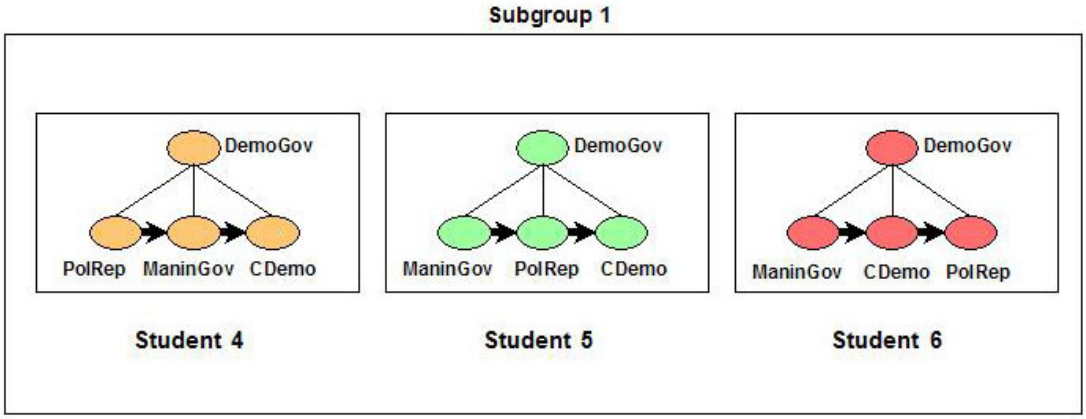

Figure 5. Execution of advanced students who prefer detailed information

As it has been shown, all the advanced students (regardless the type of information desired) chose the order in which they wanted to accomplish the subtasks. However, depending on the type of information desired, the system presented or not the collaborative activity, which corresponds to rule 1 and rule 2 in table 2. Regarding the six students without previous knowledge about the subject (novice students), they ought to accomplish the individual activities 'Intr', 'ManinGov', 'PolRep' and the collaborative activity CDemo in strict order (see table 1, sequence AND).

When the students click on the corresponding link to start executing a collaborative activity, the collaborative workspace is generated according to the user model. For example, as it is shown in figure 6, the workspace generated for advanced students is different that the one generated for novice ones. Advance students with visual learning style will be presented with a workspace that contains the problem statement associated to 'StCDemoB', as well as a graphical editor and a chat in the main interface, and a textual editor, e-mail and file sharing as additional tools. The collaborative workspace generated for novice students is constituted by the problem statement 'StCDemoA' and the most suitable collaborative tools depending on their learning style. For novice students with visual learning style, the collaborative tools are the same that those provided to advanced students with visual learning style (see figure 6), while in the case of novice students with textual learning style, the collaborative workspace would be formed by a textual editor and a chat as main tools and email and file sharing as additional tools.

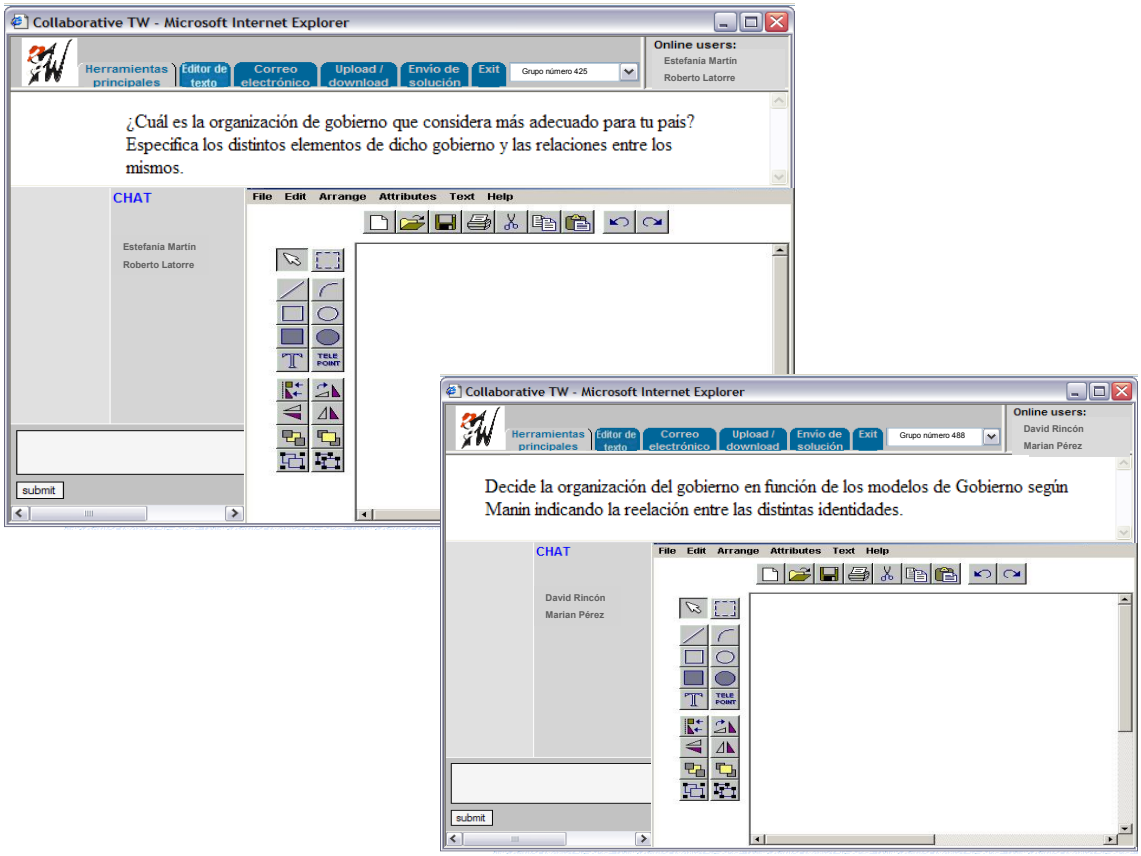

Figure 6. Different workspaces for different groups of students executing the same task

Concerning the group formation, the students are grouped in subgroups constituted by three persons, according to the criteria established for this course. The course-structure rules provide a first grouping during the course execution, given that the presence/absence of collaborative activities is specified in them. Novice students and advanced students that prefer detailed information are grouped when they are ready to accomplish the collaborative activity (see tables 2 and 3). Furthermore, the learning style is taken into account (phase 1, Fig. 1) to adapt the collaborative tools (see table 4). The subgroups for the accomplishment of the task CDemo are formed according to the time at which the students are ready to perform it (phase 2, Fig. 1.). If a student is ready but there are not enough partners to start the task execution, the link to this task is annotated with yellow colour, which helps the student to know that it is necessary to wait for other learners to start accomplishing the task. When enough students are ready to perform it, the subgroup is constituted and this is notified to all its members (by activating the link to this task), so that they can start performing the collaborative activity.