Group Learning Histories for Wikis

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Abstract: Wikis are an important part of collaboration in E-Learning, as they allow easy modification of other contributors and integrate multimedia elements. Versioning of changes is built-in, but this refers to individual actions of one person only. Especially in E-Learning both aspects can be problematic, as not individual changes but larger activities are needed for a personal learning history, and because of group work an aggregated history of several persons is desirable as well. This paper presents the basics for deriving group histories of activities from individual actions and presents an exemplary implementation of this in a Wiki within a learning environment.

Key words: Group adaptivity, learning history, E-Learning, Wiki

1. Introduction

Cooperation between learners is a necessity in most pedagogical approaches, although currently only often weakly supported in E-Learning. One typical example of cooperation is group work, where some artefact, typically a text, is created in a joint manner. If learning takes place in a distributed setting, this is typically performed through a Wiki, enabling the integration of other elements beside text and a networked structure through links, in addition to its multi-user capabilities. Technologically this is not a problem, as most learning platforms support this. However, their embedding into the course as well as the support for some kind of user-friendly history is lacking (Paramythis/Mühlbacher 2008). This “history” would be useful for a multitude of activities: because of the asynchronicity persons must get up to date on the latest changes, coaches should be able to identify the progress easily, and teachers may need measures of cooperation to decide, whether to take some remedial action, or perhaps even for assigning marks. This already applies to a fully non-IT setting, where e.g. assigning a mark to each student based on their group’s joint result is more difficult than if each learner’s work can be assessed separately. The lack of direct observability in an electronic environment exacerbates this. Moreover, asynchronous activities render this even more difficult, as sometimes even identifying the “group” can be difficult. Some technological support is therefore desirable. This can take the form of a “log” of collaborative activities (which need not necessarily have been performed at a single point in time or simultaneously). This can serve also as a first step towards documenting and assessing them and for later reflection and improvement. In the case of a Wiki it is very important that such activities, although based on individual learner's actions, should not remain tied to a single person only, but include the activities of others, encompassing the whole group; see Figure 1 for a graphical description. This group learning history can then be the basis for improving or enlarging the learning cycle: if the current state or quality is unknown, changes cannot be based on evidence and verification of new approaches is very hard. Additionally, introspection and reflection as an individual learner as well as within a larger group become possible.

One preliminary step for documenting group activities in a Wiki is to determine, which learners of all users constitute a “group” working on a single “product” (Figure 1: actions from which learners should be integrated). This can be quite trivial if explicitly represented groups working on a shared result exist: a group receives a separate section in the Wiki (or even a separate installation), its members are assigned rights on it in the learning platform, and all of them edit one page at some time during a defined period. But typically one Wiki is used for all groups of a class and there is no maintenance and enforcing of separate rights for each group. The latter has also pedagogical reasons, as typically cooperation and interaction should be fostered, so learners looking into “foreign”, i.e. those of other groups, parts of the Wiki are at least acceptable, if not encouraged.

Another issue is integrating the activities of several persons into a single “documentation unit”, typically a single section of text summarizing this shared or common activity (Figure 1: how to produce
the content of the learning history entries from the collaborative activity; \( \mathbb{2} \) and \( \mathbb{3} \). For this cooperation is split in two aspects: The changes occasioned by each student and what the group modified as a whole. In a Wiki the former are the modifications a person authors (additions, removals, changes) and the latter is based on the resulting page or the (consolidated) modifications (e.g. only the last version of changes to the same section). While the former can be documented quite easily and in many learning platforms already is (tools like “recent activities” or “new pages”; trivial for Wikis because of versioning), the latter is our prime target here. Individual actions or activities are logged for each person separately, however the personal log should at least integrate the actions/activities of other group members as well, enriching the individual learning history by group activities.

![Diagram of Learning History](image)

**Figure 1:** From actions over activities to personal learning history entries

### 1.1 Personal learning history vs. Wiki versioning

Though Wikis can typically be modified directly through a web interface, their most important aspect here is the versioning feature they usually contain. Because of their openness, where a multitude of users can participate, this is an important necessity. Reasons for versioning are e.g. reverting to previous versions because of vandalism, error, etc. or to allow apportioning praise as well as blame – the latter perhaps also in legal proceedings. But what this versioning typically provides is very technical information: At a certain point in time a specific user changed the following characters/lines/added an image/… The reason for this is, that this allows reverting (or going forward) within the modification graph.

In contrast to this a “personal learning history” (PLH) is a log describing activities, achievements, problems, or experiences over a longer time for later reference and reflection. It is therefore focused on the person performing the changes as compared to the changes themselves in the versioning system. Also the aim differs, as a PLH should help identifying problematic learning styles (perhaps also difficulties with specific learning content, but only as a side effect). It addresses mainly the learners themselves, but in a wider sense also coaches and teachers, the latter for improving their instruction. This forward looking aim is potentially problematic, as at the moment of documenting the soon-to-be-past it is not yet clear, what specifically will be of use in the future. I.e. it is trivial to document the past (=versioning history), but which activities will be important later on is difficult to foresee. Documenting all of them is also suboptimal, as a reduction in information (selection, summarization) is what makes a PLH useful: A shortcut to the important elements. Entries in a PLH should therefore not just describe what small actions or individual/group activities took place, but ideally incorporate background information too, like a summary of the content or the context (surrounding text, content of pages links were created to etc.), intentions for these activities as far as can ascertained (e.g. typo correction, important changes like introducing negations or exceptions), the
procedure how it came to be (how many users participated in shaping this paragraph into the current form), reasons for the results (associated comments, if supported by the system, can be helpful here), or references to activities of other learners or other groups. Such cross-connections allow comparisons and can enhance future use through diversity, as not every participant would create an identical summary (or receive an identical automatically generated one) for their PLH, so reading several or all of them together enhances the overall picture, and the differences provide incentives to look at the logs of the other group members or other groups and perhaps discuss them.

While the versioning history in a Wiki can be created fully automatically from the system, this is not possible to the same degree for a PLH. Reasons for this are manifold, the most important being the move to a higher level of abstraction (complex activities instead of individual actions). Ideally such a PLH would be created manually by both learners and coaches/teachers. However, especially the latter cannot do this for each learner individually. Learners themselves are also often reluctant to go through the additional work of reflecting on some learning activity. Although this cannot be completely replaced by a computer-generated PLH, with advanced technology and through accepting limitations and potential quality problems one can be created automatically. This can then be refined manually or serve as a first approximation.

1.2 Group adaptivity

In the context of E-Learning “adaptivity” (Kareal/Klema, 2006) means to adapt the learning environment to some characteristics of the individual learner. Examples for such characteristics are the presentation (font size/no images/… for people with disabilities; e.g. AHA by De Bra et al. 1999), the content (showing different texts explaining the same concept dependent on the learning style, pre-knowledge etc.; e.g. ELM-Art; Brusilovsky et al. 1996 and Weber/Brusilovsky 2001), or navigation (like link hiding, learning path construction, or adaptive navigation; e.g. InterBook, Brusilovsky et al. 1998). While these were developed for more “traditional” E-Learning with electronic forms of text books, they apply to Wikis as well. E.g. the presentation can be modified programmatically or through different stylesheets quite easily. Link annotation as an example of adaptive navigation support works well too. However here, and especially regarding content adaptivity, a lack of metadata for the content is potentially problematic, as most strategies for adaptation are based on it. If a section in an electronic book is marked as “introductory” it can for instance be hidden by default for experienced learners and shown only to beginners. But in a Wiki such markings do not exist – they must either be added manually (and potentially removed/changed/added on each modification!) or derived automatically.

But adaptivity is not restricted to individual persons – it can be applied to groups as the target as well in two different ways. Individual adaptation based on group information means to enhance a PLH by information applying to the whole group. This results in a learning history where the individual activities are described in the context of the activities of the group, broadening the view and thereby enhancing the possibilities for future usefulness. Another approach is to adapt the learning experience not for a single learner but for a group as a whole. Regarding learning histories the result is a shared group history applicable to all members of a group, documenting e.g. the collective progress as opposed to the individual one in their individual personal learning histories. Of course this requires that information on the group as a whole is present as opposed to data on each individual learner only. Here questionnaires are of limited value, as shared answering a single form is inconvenient for learners, and with multiple forms their aggregation is difficult. Therefore it is necessary to generate the required information on the group from firstly observing the individual actions of users, secondly aggregating these actions into individual activities, and thirdly coalescing the individual activities into group activities.

2. Integrating group adaptivity with personal learning histories

When introducing group adaptivity into PLH, several design questions and implementation difficulties arise. The first is the degree of integration of group activities: between solely individual ones and completely shared group histories a wide range exists. A second one is the vertical integration of actions into activities. Logging characters typed is easy, but not so useful as semantic annotations, like “added rebuttal”. This ties in with adaptivity, where also higher-level constructs are necessary for the decisions on adapting presentation/content/… A third aspect is privacy. Care must be taken to clearly separate “private” activities from shared ones, as well as which persons constitute a “group”, and therefore receive the shared portions of the group PLH. The last aspect to be covered here is whether PLH entries should be static or dynamic or to what degree a mixture of both.
2.1 Degree of integration of group activities

The extent of integration of group aspects into a PLH is a design decision, limited by the implementation techniques available. Such a PLH consists of three parts: One pertaining to the individual user, one to the group as a whole, and the one interesting (and implemented) here, a mixture of individual and group aspects. The aim of integrating group adaptivity in PLH is therefore to provide an “abstract” of the *aggregated individual learning history* as embedded within a larger group for later use, with a special focus on activities related to cooperation. It should be “aggregated” as it often makes sense to rework an existing PLH entry instead of adding a new one. This especially applies to Wikis, where, as opposed e.g. to chats or video conferences, no clearly delineated “session” concept exists. The middle part, where individual and group activities are integrated, can be subdivided into the following finer variations:

1. Individual activities with possible relations to other users: Although only pertaining to a single learner, cross-connections to others are created or proposed. Examples include whom to ask for advice relating a specific problem or section of content or helping group formation through suggesting possible persons for cooperation or collaboration, based on their individual knowledge or interests. Another option is suggesting material to “cover”, grounded in information on who created it, commented on it, has already completed associated quizzes etc. In the case of a Wiki this could be e.g. which page/section/paragraph to review or where additions might be possible (good own knowledge as compared to weaker knowledge of the author, etc.).

2. Individual activities enriched by information from a group: In contrast to the previous category here not another user or their data is the basis for individual recommendations, but some information associated with them is integrated into the PLH directly. This can be information from individual users, for instance modifications made to or deletion of material created by this user, or a group, e.g. the average size of contributions within a Wiki or the count of new pages added.

3. Shared activities: If several persons perform some activity together, integration into a PLH becomes much easier as no aggregation is necessary. Examples for such activities are shared editors (collaborative editing of a single document) or any individual activities where several persons use a single computer (hard to determine from within the system!).

4. Special relations to a subset of the group: If groups are defined explicitly (e.g. assigned by the teacher) or are large, it can be useful to identify a subset of members with whom a large overlap (similar knowledge or activities) or frequent relations (communicate often) exist.

2.2 Vertical integration of actions into activities

A difficulty of group adaptive PLH is the selection of users who constituted a “group”. Approaches for identification can be based for instance on existing explicit representations, e.g. the organizational structure (users with certain rights on a Wiki page, created in the same batch operation, similar knowledge and educational level in their ePortfolio ...), or comparing their actions (even better: their activities) to identify common “signatures” and assembling a group based on similarity. Examples for the latter are all persons working on the same page or topic, using related words from an ontology for annotation of diverse content, integrating the same resource (e.g. images) or such from the same source (i.e. frequenting the same external websites from which they integrate materials).

Actions are often not monitored directly but rather through events, i.e. each subsystem of a learning environment, such as a Wiki system, a chat/forum module, define what they see as an important and potentially interesting event. These are then distributed to all interested parties, commonly through a central event bus and the observer pattern. Such events are typically, but not necessarily, the direct and immediate results of an individual user’s action (examples: chatroom created/deleted, chat message posted, quiz created/filled in, Wiki page creation/modification/reversion, ...). By comparing these events, common signatures can be identified in certain cases automatically. If they differ only in a single element, e.g. the user who caused it to be fired, then some “common” or “similar” activity took place. Obviously this still requires some abstraction, as for instance the time will usually be a differentiating factor as well as the content: two chat messages at the same time in the same room, but with different content; additions to the same page/paragraph of a Wiki page, but with different text/addition vs. deletion vs. modification. In some instances events might be related if they occur within a short time span, but regrettably this is not a universal role. For synchronous communication tools this is important, but for asynchronous ones it is not. Conversely, similar/identical content might be interesting in quizzes only if incorrect, as correctly answered questions can often be ignored (only...
the general level of knowledge is useful for adaptation), but for incorrect answers the question itself, respectively its topic, is useful. It is therefore impossible to conclude from neither one common element (same user in both events) nor everything identical but one element (solely a time difference) on a relation between events. So it is a necessity to determine the rules for each “application” separately: a Wiki requires different rules for detecting “related actions” than a chat room or some online content for self-study. This is especially problematic when trying to introduce connections between such tools, as each pair of tools requires a individually tailored solution.

### 2.3 Privacy issues of group-adaptive PLH

An important decision for a group-adaptive PLH history is the amount of privacy for the participants. Who may view the individual log entries and whose data is included there in a way rendering them identifiable: only the learner or also the other members of the group on who’s input it is based as well, respectively only anonymous information, data hinting an certain persons or named contributions? As it is a “personal” learning history the restricted visibility seems to be more natural. However, this visibility should match the sources used for its generation because of equality. This is especially important for a Wiki, where typically the history entries for a page are assigned the same rights as the page itself, i.e. who can change a page can also see who else changed it and the content of the modification, respectively the previous version, too. But there exists a difference between what can be seen separately on each history-page, and a short summary across several of such pages delivered proactively to users. Some middle ground seems to be most appropriate: very important contributions by individual other users might be personally attributed, but most information should be rather statistical in nature. If, as often a pedagogical aim, the individual learning history entries are visible to other users as well, this applies to information about the user him-/herself as well. While they know what they have done themselves, this publication of the PLH makes their own contribution worthy of protection as well. However, this is a difficult approach, as the PLH then becomes less useful not only for others, but also its “owner” as well. A useful compromise could therefore be to include personal information, both own and of third parties, but base it on reciprocity. If data on a third person is contained, this person can view your entry as well. So dividing a class into smaller subgroups, with “strong” privacy protection between groups, but little or no privacy within a group, seems to be a promising approach.

This privacy need is however not the same for every PLH entry. Each one might be part of a different activity within a separate group, so if you participated in that group you can see the entries of the other participants as well – but only insofar they refer to this activity, while other remain “hidden” for you. The result is a “fragmented” personal history: the owner can see all entries, but third persons see only a varying individual subset – those entries they are related to somehow. In this way the group history is accompanied by group visibility with the additional advantage, that comments by other group members become possible – something not available in purely individual histories. The reason behind this is, that if a PLH entry remains accessible to the individual it pertains to only, solely manual additions or modifications, or personal comments to automatically generated entries are possible. But if others may access these entries too, they can comment on them as well, opening up further possibilities for collaboration and providing perhaps a new point of view on a topic, or for starting or improving reflection on the activity.

### 2.4 Static or dynamic PLH

Whether a PLH entry is created once and remains identical in the future, apart perhaps from manual modifications like comments, or is updated continuously is another important aspect. Such automatic modifications might happen never, whenever the user this entry belongs to performs a new action/activities, or whenever anyone causes some change in materials influencing this entry. The latter is especially interesting regarding Wikis, which are themselves very dynamic. For instance an entry might contain information on an “important” new paragraph introduced by the PLH entry’s owner. If this is deleted later on, the PLH entry would becomes less useful. So either a new entry should be created (perhaps without any action related to this paragraph by the owner at all), or the original one should be modified to include this new state. Considerations for the decision must include:

- It must be decided when exactly a new entry is generated and how this is going to be implemented. If it should happen every time the entry is viewed, an extensive logging/timestamping mechanism is needed to prevent re-calculating a complex procedure on every request, but still show changes immediately. If recalculating all entries on every activity is desired, a reverse-mapping and a filter, indicating which entries might be affected by which
activities, is necessary (recalculation on actions instead of larger activities should not be tried, as this will produce a huge load and lead to changes in PLH entries only rarely!).

- Changing entries might confuse users, as they remember them differently. This is especially problematic if comments are possible, as then the manually added content might suddenly become redundant, incomprehensible, or misleading. In this case a new entry might be better suited, ideally associated with the original one. Connected with this issue is also the question of all kinds of links to such entries.
- Will the old versions of the entry be accessible, e.g. in a kind of versioning system? In a Wiki environment the PLH might be implemented technically like a special personal Wiki page, with automatically generated texts, so such a history would be maintained automatically. For more typical bases like blogs or forums this will have to be implemented separately and add an unfamiliar function to a common artifact, requiring a good user interface.
- From the privacy aspect it must be determined how the visibility is handled. If e.g. an entry can be viewed only by very few persons and a “private” comment is added, then later extending the visibility because of an enlargement of the group involved with this part of the Wiki renders it suddenly “public” without human intervention. In the reverse direction it might happen that someone added a comment and later is removed from the visibility, losing all access to her/his own comments – and perhaps all later replies to them by others.

This is therefore a very important decision and needs careful consideration. If not completely sure about the consequences, a more static approach seems better. However, this suffers from the drawback that the PLH might become crowded very fast, reducing its usefulness.

3. Exemplary implementation

A personal learning history has been implemented as an addition to the learning platform Sakai (2010). It is based on a blog tool, as this resembles a learning history best: several independent entries for each other, which can be commented upon or modified by the creator or others, are associated with access rights etc. In this way also a user interface is available automatically, which had only to be adapted for added functionality, e.g. the group visibility.

Manual entries can be added to the PLH as well (based on the normal blog functionality), or the automatically generated ones modified. In additional to these main entries comments to them are possible. Regarding the access rights, everyone who can see an entry can also comment on it by default (can be changed manually if desired), but only the owner of the PLH can change the main entry. Visibility is by default to all group members and is separate for each entry, but can be changed manually to fully public or private, affecting all comments to it as well. As groups vary from entry to entry, no “canonical” form of a specific PLH exists except the one for the person it belongs to, its owner, who can see all entries.

Which persons are considered as a “group” is not defined in the general implementation. Each tool defines this on its own. Therefore the history consists of elements originating from various tools, each possessing a different concept of “group”. This might be confusing but is unavoidable, as a learner can for instance be member of two differently composed groups in two courses attended during the same semester, which must be mirrored not only in the content, but also the access rights, even if both stem from the same tools. Other group members from one course should not be able to see or modify the entries belonging to the other course, unless they are in the same group there as well. At the moment the logic for defining these adaptivity elements (which persons constitute a group, what to log exactly etc.) are hardcoded, but a promising approach is employing a modelling language for easier modifications or perhaps even meta-adaptivity (Paramythitis/Cristea 2008).

Three tools have been enhanced to contribute to the PLH at the moment: The chat room and a custom generator for exercises, which creates new cases in a special field of law for learners to solve. The third tool is the Wiki, which is covered below in detail.

3.1 Implementation of the PLH for a Wiki

The PLH for the Wiki is based on the already existing Wiki tool. Regarding the history entries only modifications of the content are taken into account: adding, changing, or removing page content. Other actions are ignored, e.g. viewing the page or the versioning history. For each Wiki only a single entry is created, allowing e.g. statistics spanning all pages modified by this user. Entries for each page could also be useful, but would then require detailed information on this page alone, e.g. summarization, to become useful. Such techniques have not yet been integrated, so such entries
would not be very helpful at the moment. Regarding the problem of dynamic vs. static content, for this tool the decision was made that the PLH entries are dynamic, i.e. they change every time the Wiki is modified without any restrictions (e.g. comments present → no change).

3.2 Group formation

Which users constitute a group is calculated automatically based on the page contents. This means, rights on the page (who can view/modify it) are ignored and only actual contributions are counted. So everyone who modified a page which this user has modified too, becomes a member of the group. I.e., if a user adds some text to a page, a PLH entry is generated, which can be viewed by all persons, who worked on this page or any other page modified by this user in the past. This is obviously a useful measure for the page itself, as they all contributed to the work product which was subsequently modified. The extension to all other pages worked on by this user is grounded in the reason that the PLH entry applies to the Wiki as a whole and not individual pages. However, this algorithm also has a drawback: even if someone makes only a tiny modification, like changing a typo, all associated PLH entries become accessible. Therefore a possibility for improvement in the future is restricting the group to users with “significant” contributions, but these are not necessarily easy to distinguish.

3.3 Content of a Wiki PLH entry

Because of this rather wide definition of a group, privacy is important and therefore much information in a PLH entry is based not solely on the individual user or of statistical nature. I.e., the focus of such entries lies on the group history aspect and less on the individual history. The following elements are calculated (see below) and shown in the entries:

1. The number of new pages created by this user: A measure for the high-level activities, showing the initiatives of this user. This is only a number, as the topic of the individual pages are not that important unless also filled with content, but then they will be shown on the list of most modified pages.

2. The number of lines added or modified by this user: A very rough measure of the activity of this user. The more lines have been changed, the more content was added, modified or deleted. Typically lines are not that long, so even small changes to a line warrant counting them in full.

3. The number of lines created by other users and modified by this user and those created by this user and modified by other users: This is a measure of how “acceptable” and/or “correct” the content by this user is. If all lines created by this user are modified by others, they might be wrong or are at least not universally acceptable (and vice versa). Especially the latter is very important for discussions and cooperation, which are based on finding a consensus. The same applies to the second counter. Additionally they measure the “partitioning” of the group. If everyone only works on their own paragraph but never even looks at those of others, these counts will be low. But if they read and modify the content of others, actual cooperation is taking place, which is typically the aim of a Wiki in an E-Learning setting.

4. The top five pages with the most modifications by this user: Where this user concentrates his or her work. This could be further used for identifying the (current) interest. The number of modifications is calculated through the count of lines modified.

5. A rough measure of the collaboration with other users: This depends on item three of this list (foreign lines modified and own lines changed by others) divided by the amount of new content contributed for normalization. The geometric middle of both values is then used as a measure how “overlapping” the work has been. If every user works on his own content only, it is zero, if everyone works significantly on other users content, it is higher. This will work only for users on the same level, as e.g. a teacher correcting the works of learners would attain a very high measure of collaboration.

What is explicitly not part of the PLH entry is the last change by the user it belongs to or a summarization of changes. The reason is the wide definition of a group. Such entries would be more suitable for a more personal history or for more restricted definitions of groups.

3.4 Technical implementation

As can be seen from the PLH entry content listed above, it is very important to identify who contributed some text to the Wiki and who modified it. As this information is not stored in the Wiki, it had to be generated from other information. A separate storage would be an option, but this would require
extensive modification for logging, storing, and accessing this data. However, based on the versioning history, this data can be extracted as well, requiring no additional input, but needing more computational effort. In the exemplary implementation the difference between two consecutive versions is calculated, which is then attributed to the person who submitted this new version. As an example, to identify whether content from a different person has been modified, the current version is compared with the previous one, resulting in the set of changes created by this user. Then the previous version is compared with the one before to identify the contributions of that user. If these two differences then overlap, some "foreign" content was modified. For a complete assessment this procedure is repeated until reaching the first version of the content.

3.5 Possible improvements

Complementing these very group-oriented PLH entries with more individual ones could be helpful, which would require information useful for the individual learner. Examples could be a summary of the last changes (difficult, as these might be quite “distributed” across even a single page), a dynamic notification on own content having been modified (or perhaps only: deleted) by other learners, or addition/modification by others which might be interesting to review. In short: pointers for “checking” modification of own content by others as well as where such content by others might be inspected for improvements. Statistical data might include a list of pages or paragraphs changed most often, as these are probably important or useful for later reflection: why were they changed so often, who modified them in which direction etc. Similarly interesting could be pages (or again subsets like paragraphs) which have been reverted to a previous state often. Technically this would have to be implemented similarly as described above by comparison to previous versions as the Wiki in the learning platform Sakai doesn’t store any information on reverts (these are just ordinary changes of the content).

In a wider context integration of the PLH entries of the Wiki with those of others tools might be advantageous. If it is for instance possible to connect a chat discussion with the Wiki, e.g. both open concurrently by all participants and on the same topic, content from the other learning tool can be integrated or links added to their PLH entries as cross-connections.

4. Conclusions

In a collaborative E-Learning setting Wikis play an important role. But their use can also result in fragmentation, when every learner works on his “personal” Wiki page and ignores those of others as far as possible. Then it becomes important to increase communication and cooperation, e.g. through a personal learning history which also includes information on other learners and is not purely an individual log of activities. If work on a Wiki is actually performed in groups, then such a group history is useful too, as it serves not only to document the group work (for the learners themselves as well as thirds, e.g. coaches or teachers), but also as a source for future reflection.

A practical evaluation of the system will take place in the summer term 2010 in the context of a course on privacy law. Small groups of students will work together to solve cases or formulate an application for the processing of personal data, developing the result jointly on such a Wiki. Whether the personal learning history was helpful and encouraged discussion will be investigated with questionnaires.

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Literature


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