

GROUP-ADAPTIVE PERSONAL LEARNING HISTORY

Michael Sonntag

Institute for Information Processing and Microprocessor Technology (FIM)
Johannes Kepler University Linz
sonntag@fim.uni-linz.ac.at

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Abstract

Documenting collaboration is an important prerequisite for its improvement or reflection on it. But learning platforms usually support logging individual actions only, falling short in two aspects. Typically not the small actions (like individual mouse clicks) but larger activities (working through a chapter) are of interest, and regarding collaboration the individual contribution (a message sent) is important, but its context, the group setting (frequent collaboration with a certain group of other students) should be included as well. A group-adaptive personal learning history is described as a solution for these problems. Individual actions are aggregated to larger activities and these are then used to generate individualized log entries to a personal history log. An exemplary implementation for two tools is presented to show the viability of this approach.

1. Introduction

Cooperation between learners is a necessity in most pedagogical approaches, although currently comparatively less supported in E-Learning from the didactic point of view. Technologically all manners of communication are supported, but their embedding into the concept of a course as well as the support for cooperation (based on, but different from communication!) is lacking (Paromythis/Mühlbacher 2008). Also, unlike individual activities the steering and documentation of communication - and especially collaboration - is more difficult. This is true for humans, 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. In E-Learning this is more complex as it must be done not only automatically but often also for asynchronous activities, where even identifying the "group" can be difficult. It is therefore desirable to create a "log" of collaborative activities (which need not necessarily have been performed at a single point in time or simultaneously) as a first step towards documenting and assessing them and for later improvement. It must be noted that such collaborative activities, although based on individual learner's actions, should not remain on the single person level but include the actions of others, i.e. encompass larger units (like discussing a certain topic with a list of persons) instead of individual events (for instance posting a message in a forum); see Figure 1 for a graphical description. These activities can then serve as the basis for improvement or enlargement of 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 is identifying which learners constitute a “group” working on a single “product” (Figure 1: actions from which learners should be integrated; ❶). This can be quite trivial if explicitly represented groups working on a shared result exist: A group receives a separate workspace, its members are assigned rights on it in the learning platform, and all of them edit one document at some time during a defined period. But in more unstructured and ad-hoc cooperation, like chats or forum discussions, this becomes much more difficult.

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; ❷). For this cooperation is split in two aspects: What each student performs as a person, and what the group does as a whole. For example, in a chat or a Wiki the former are the messages or modifications a person authors and the latter is the chat as a whole or the resulting webpage. While the former can be documented quite easily and in many learning platforms already is (tools like “recent activities” or “new pages”), the latter is our prime target here. Individual actions or activities will still be logged for each person separately, however they should at least integrate the actions/activities of other group members as well. In this way the individual learning history is enriched by group activities. Collaborative actions as such are however identical for each member of the group and therefore exist only once and are shared between the personal logs of all members (Figure 1: Group learning history entry).

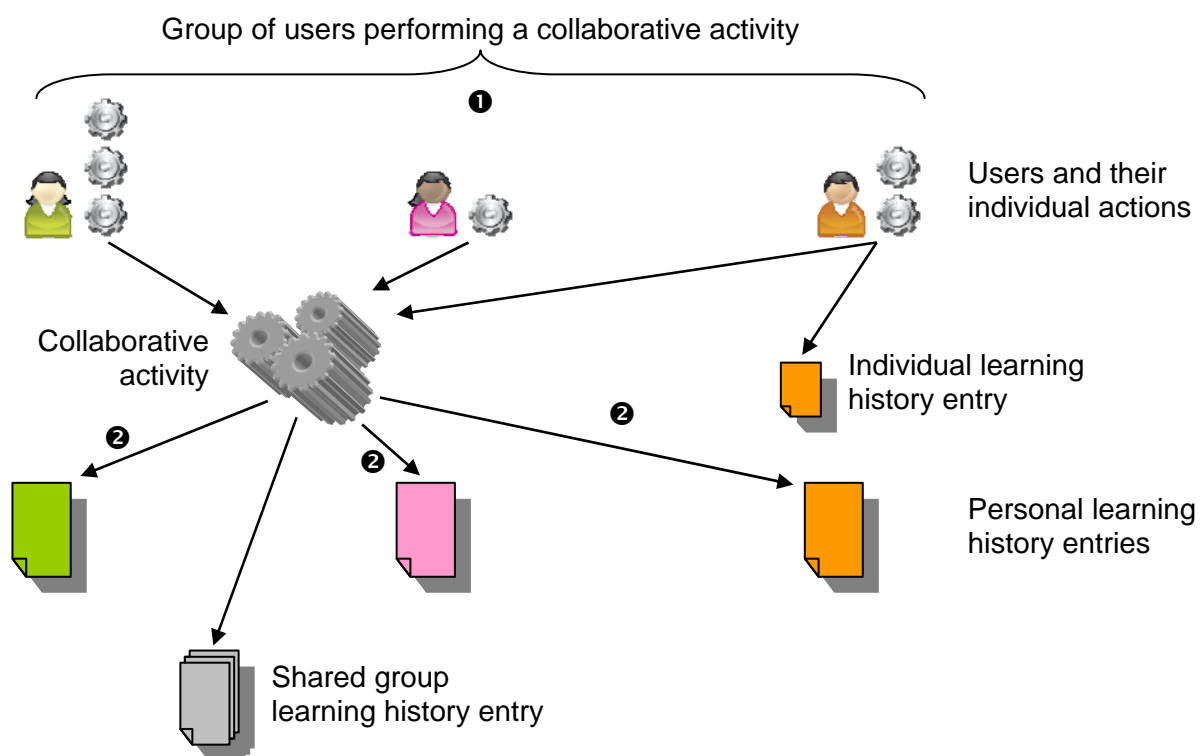


Figure 1: From actions over activities to personal learning history entries

1.1. Personal learning history

A “personal learning history” (PLH) is a log describing activities, achievements, problems, or experiences over a longer time for later reference and reflection. In this way it becomes easier to identify problematic areas in learning style (not necessarily regarding specific learning materials) or detect areas for future focusing: how to improve the learning path (→ teachers) or better learning methods (→ learner). Such a history can be generated manually or to some degree also automatically. Examples for the latter are reminders/notes when a report has to be - respectively had been - submitted. Notes taken during an online or offline course or during studying learning materials are examples of the former.

Personal learning histories aim at providing an opportunity to improve learning from past experience. They foster life-long learning and may be used as the basis for ePortfolios. With them learners can “go back in time” and review their progress. Depending on the educational model such a history might be part of the marking by teachers as well: assessing not only the absolute level achieved but also the progress made. In a variety perhaps more acceptable to learners such a history can be used to improve guidance by coaches. They do not need to elicit the current problems of the individual learner but can obtain an overview on these by inspecting the personal learning history.

As a PLH is a condensed report on past steps in the learning cycle focused at being helpful in the future, it should be created with two aspects in mind: documenting the past and improving reflection in the future. While the former is quite easy, it is partly at odds with the latter. Although documentation is trivially possible automatically e.g. by recording every single mouse move, key press, or action in a learning environment, such detailed recording will be useless for (and in) the future as too much information is stored which is typically of no interest at a later point in time. On the other hand, what is important in the future is mostly unclear at the moment a log entry is created. Therefore some aggregation is necessary to keep the PLH brief, yet retain all necessary information for possible future uses. Entries to the history should therefore not merely describe what occurred, but also incorporate some background information, like intentions for these activities, the procedure how it came to be, reasons for the results, 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 of a discussion will 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 as the other group member’s logs.

1.2. “Group adaptivity” and its subdivision

Adaptivity (Kareal/Klema, 2006) means in this paper’s context to modify the learning environment to the properties of the individual learner. This can be performed in various ways, e.g. using a different display (larger font/no images/... for people with disabilities; e.g. AHA by De Bra et al. 1999), showing other content (depending on the individual learning style, pre-knowledge etc.; e.g. ELM-Art; Brusilovski et al. 1996 and Weber/Brusilovsky 2001), or providing guidance through content (adaptive navigation; e.g. InterBook, Brusilovski et al. 1998). However, such adaptivity is not inherently restricted to an individual person but can be applied to groups as the target as well in two different ways: individual adaptation based on group information, or adaptation not for an individual but for larger groups. The latter can be exemplified through providing specific additional learning materials to all students who graduated from a general school alike, which is omitted for those from technical ones. An obvious prerequisite is that this group’s properties must be known

instead of merely data on individuals, which can be implemented e.g. through explicit questioning or observation of individual's behaviour + integration/generalization. The second approach is adaptive elements for individuals based on other's activities. E.g. individualized learning examples are presented to each user separately, but their generation/selection is not based solely on his/her results but also on that of a larger group, e.g. taking into account general (as opposed to individual) difficulties in understanding as well. In short, group adaptivity can be based on adapting something for a single person based on information on a larger group (group-information based adaptivity), or adapting for groups as a whole (adaptivity for groups). In this paper we focus on the first, although PLH is possible for the second equally.

2. Group adaptivity in personal learning histories

Integrating group adaptivity into PLH is based on one of the two group adaptivity possibilities. An individual learning history for a single person is created – although perhaps visible to others as well (see below) – which takes into account activities by other “nearby” or “similar” learners, i.e. a group. In the current implementation each log entry is tailored to the associated person, although it is based on a shared basis (which itself might be used for a group learning history). 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.

Based on the amount of influence on the entry, group adaptivity in PLH can be subdivided into the following finer variations:

1. Individual actions: This is actually neither group adaptivity nor PLH, as only individual elements and solely actions are logged for each person separately. However, it can be used as a fallback and as the basis for the improved approaches below. Examples for this are the upload of a finished assignment or notes taken during a lecture or while working through learning materials. The exemplary implementation does not create such entries.
2. Individual activities with possible relations to other users: While still only pertaining to a single individual, cross-connections to other students are made, e.g. whom to ask for advice to this specific problem by taking into account the activities of a larger group (see 3.2). Another example is helping group formation through suggesting possible persons for cooperation or collaboration.
3. Individual activities enriched by information from a group: The data logged to the learning history includes information on other members of a group. This group might be the same for all entries or could be different for each category or even each log entry. Examples are progress within the learning material as compared to the whole class (could be a static or a dynamic comparison, i.e. compared at the time of log creation or at the time of viewing) or a summary of a chat with statistics on how frequently/verbosely oneself or the other participants said something (see 3.1).
4. Group activities: These refer to activities where individual actions still exist but can be distinguished only with difficulty or make little sense on their own, so only the collective activity is logged any more. An example for this is a Wiki, where individual modifications might be very small (adding a few words here, inserting an arrow and a textbox there ...) and only the overall progress is useful to retain for future review in a separate entry (see also 2.2).

In the following subsections three important aspects of group-adaptivity in PLH are discussed: Group visibility as a bridge between individual and pure group entries, how to aggregate simple actions into larger activities (to then log them), and how to create a useful documentation of a real group activity (paragraph 4 above), based on a Wiki as an example.

2.1. Aggregating actions into activities

A difficulty of group adaptive PLH is how to define the “group” for an activity. Approaches for identifying a group can be based for instance on an existing explicit representation, e.g. the organizational structure (all learners in a course, all participants in the learning platform with certain rights on an element, ...), or comparing the individual actions to identify common “signatures” and assembling a group based on “similar” action/activities (e.g. all persons participating in a chat or reading the same section in learning materials).

Actions are often not monitored directly but rather through events, i.e. each subsystem of a learning environment, such as a chat/forum module, exercise generation tool, or a quiz, defines what itself sees as an important and potentially interesting event and distributes this to all interested parties, perhaps through a central event bus of the platform. 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, exercise generated/started/finished/marked, quiz created/filled in, Wiki page modification, ...). 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” activity took place, like in our examples two persons sent a message in the same chatroom simultaneously. Obviously, this doesn’t work correct in all circumstances, as for instance the time will usually be a differentiating factor as well, resulting in already two differences. If the events occur within a short time span, they are probably related (two messages within a few seconds in the same chatroom by two different persons will have something to do with each other – at least the other participant has read it). But if a longer pause exists they could be completely unrelated as well. For instance two separate subgroups of a course use the same chatroom on different occasions or exercises from a generator have no overlapping common ground. This is complicated by the fact that no general rule is possible when two events are related, as e.g. the time difference is of little importance in a Wiki as opposed to a chatroom, but there the spatial difference (which page within the Wiki has been changed) is important (which doesn’t even exist within a chatroom). Therefore generic aggregation of individual actions can only serve as a first approximation.

An improved approach must therefore rely on hints for (or by) each event source or type what can be considered as “related events”. This may include differences solely over time, i.e. where the same person causes an event to be fired repeatedly. This is important for a group adaptive PLH too, even though it applies to a single person only, as an improved information source on a group member enhances the group assessment as well. An example is, that repeated “successful” events (e.g. for a quiz) can be integrated into an “expert status” to be used for the adaptivity categories 2 and 3 (possible relations and enrichment) described above. Obviously this requires an event history storage so that previous events can be compared to or integrated with new ones, in addition to merely acting on events the moment they occur.

2.2. Group visibility

An important decision for a group-adaptive PLH history is the amount of privacy. Who may view the individual log entries: only the learner or also the other members of the group on who's input it is based as well? 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. For an individual learning history these are solely the actions of this person, resulting in a private log entry. For a single entry for all group members (=group learning history) the actions of all group members are used, so every member should be able to see and perhaps modify it (equality of all persons regarding access rights). For a personal learning history influenced by other group members, but with individualized entries based on a single person, this person should have more rights (e.g. modifying it) than the others, but the group members should not be completely excluded (e.g. just read access). Opening up the accessibility of individual entries to the group is therefore a middle ground between the two extremes of a single identical entry for the whole group and a purely personal log.

Obviously this is a potential privacy issue, as some data of such entries pertains to the person alone and is not a completely shared one. So the option to either turn off this feature or allow changing individual entries to private ones should be offered. Still, as only members of the group can see these entries there exists at least some connection between them – they are not complete strangers. Consider for instance chat messages. If the group is defined as "has participated in the chat" everyone has already seen the messages so any summary or statistics is nothing new to them. If someone joins the chatroom later, they typically have access to all the history, so even if they have not read it, they at least had the opportunity to do so. Especially in this exemplary case group visibility can be useful, as instead of having to re-read all that has gone on before they joined, a look at the history of the other participants informs late comers roughly about previous developments.

An additional consequence of group visibility is that comments by these other group members are possible. If the learning history is available just to the individual, only manual additions or modifications, or comments to automatically generated entries are possible. But if others have access to these entries they can comment on them too, introducing an additional starting point for collaboration and providing perhaps a new point of view on a topic, or starting or improving reflection.

2.3. Group activities: Wiki as an example

Another issue of group adaptive PLH is, what log entry to produce for group activities, where the individual actions are difficult to interpret or unimportant, i.e. how to summarize them, ideally in addition with a focus on the aggregated contributions of a single individual. An example for this problem is a Wiki. Learners might work together in a group to create a shared page on a specific topic, each reading and improving the contribution of the others. Typically the work is split into subparts and every member of the groups writes her/his section. At this point the individual part can still be identified easily and addition to a PLH is simple. But if actual collaboration after this cooperation phase occurs, which is commonly the pedagogical intent, everyone enhances the products of the others with their own knowledge, discuss it, and improve their own part based on feedback received. I.e., a self-contained and coherent contribution of a single person is practically non-existent any more. Still there are some approaches, how such an activity could be represented in an automatically generated personal learning history. This can be done either according to the process (who did when what) or the result (representation in final outcome, resulting product).

Regarding the process one option is to produce statistics, for instance the frequency and amount of data contributed, the part of it which was (not) modified by others, e.g. measured in sentences or paragraphs, the extent of modifications to other person's contributions etc. To some degree it is also possible to identify the type of modification, e.g. through the size: was it only a typo correction or was something important changed, e.g. through inserting a negation? Through calculating the frequency of changes to other person's parts a very rough measure of the "amount of collaboration" is possible. If a person only changes its own sections, cooperation is probably low (but not necessarily, as the modification might be based on a discussion with others), but if significant alterations to "foreign" sections occur repeatedly, a lot of interaction and mutual influence takes place.

Taking into account the resulting product only, automatic summarization can serve as a replacement if a summary is not part of the resulting product. Also, those elements changed most often can be cited in the log entry, 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 are sections which have been reverted to a previous state often. Regarding the aim of documentation it might be more useful to link to the Wiki itself, perhaps specifically to sections changed often, than trying to reduce/summarize the history – which is especially difficult for the document as a whole.

Another approach is integrating external activities, like chats/forums connected with this page or E-Mails. These elements might be explicitly associated with the work product or could perhaps be related to it through their content (e.g. copied text, citations) or links.

3. Exemplary implementation

A personal learning history has been implemented in the learning platform Sakai (2010). It is based on a blog tool, as this resembles a learning history best: several independent entries after 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 the additional functionality, e.g. the group visibility.

Manual entries can be added to the PLH as well (based on the normal blog), or the automatically generated ones modified. In addition to these main entries comments 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, but can be changed manually to fully public or private. As groups vary from entry to entry, no "canonical" form exists save the one for the person it mainly 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 (i.e. chat, exercise generator, wiki, ...) can and must define this on its own (see section 2.1). Therefore the PLH 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. 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 ap-

proach is employing a modelling language for easier modifications or perhaps even meta-adaptivity (Paramythis/Cristea 2008).

Two tools have been enhanced to contribute to a PLH at the moment: The chat room and a generator for exercises, which creates new cases in a special field of law for learners to solve. Other tools like poll, forum and wiki will be extended in the future to provide a fuller view and as examples for different kinds of cooperation and allow better verification of the usefulness of this approach.

3.1. Chat learning history

For chats each chat room is considered a separate entity and therefore receives its own entry in the PLH, as conversations in separate rooms (which are in Sakai quite static and often created per course/group and not ad-hoc for a single session) typically have little in common. An entry provides statistics on the learner's participation (message and character count, i.e. how often and how "extensive" he/she participated) and who sent the last message. These are recalculated whenever the learner leaves the chat room. The "group" for this tool is defined as all persons who participated in this chat. Therefore every learner sees their own statistics in their PLH, allowing a quick assessment of the involvement and (hopefully) the topic through the chat room title.

A shortcoming of this approach is, that although chat rooms can be freely created by participants for separate tasks, often an existing and free one will be "reused". This is not detected at the moment, as even old conversations might be "restarted" after a longer interval (=same discussion), but when everyone leaves the chat room and immediately after another groups reuses it, these are different discussions. Which of the both cases occurred is very hard to determine. Session gaps, i.e. periods with no persons within the chat room can detect the second scenario, but will fail in the first. Still, it is probably better to generate a separate PLH entry for a different session with the same topic, than merging two completely different discussions.

A possible extension is automatic text summarization, which could be used to provide a better assessment of what went on in this chat or at least its main topic.

3.2. Exercise generator learning history

This is a generator for legal cases (Sonntag, 2009), which students solve autonomously and which can then be corrected with the help of an exemplary solution generated as well, similar to an intelligent tutoring system (Murray, 1999). Each case consists of several independent legal problems assembled into a single textual description. The entry into the PLH provides brief information on the current state of the case (not its content – could be possible through automatic summarization if such a service were available) and on the result of the assessment, if it has been completed.

As the main focus of the PLH is on integrating several events over time (to avoid listing only small actions, which are not interesting), the entries are here dynamic. This means, depending on later events previous log entries are modified. Here each case receives only a single log message. Whenever its state changes (generated → solved → assessed), the associated PLH entry changes as well to incorporate the new development. In a second way it is even more dynamic, as the entry lists other users which might be of help regarding the actual problems selected for this case, as they encountered this or a closely related problem in the past. These students are considered a "group" for this tool, as each learner receives individual cases for solving alone, and their only common aspect are the potentially identical/similar problems in their examples. This list is created at the moment a

user looks at the PLH entry and is not stored at all, i.e. it is completely dynamic and therefore potentially changes every time the entry is viewed. An extension of the entries to not only list such possible advisors but also contact them directly (e.g. showing them differently if currently online and opening a direct chat for them if accepted by the other learner) is planned for a future extension.

4. Conclusions

Adding collaboration-related data to a personal learning history serves not only to document group work (for the learners themselves as well as thirds, e.g. coaches), but also as a source for reflection. The important aspect for this is to not stop at recording individual actions, but integrating them into larger activities, and then combine those of several persons together. Unfortunately this is not possible on the detail level, i.e. for individual entries, in a generic way but must be tailored to each source. Only on a very high level (“persons most often collaborated with”) this could be possible. The viability of this approach has been shown through the completed parts of an ongoing project.

For the future an extension to polls and the wiki is planned. For the former a group can be identified as all persons who gave similar answers and the PLH can include statistics as a comparison how similar the own answers were to those of the group (“mainstream” member of group or on its border) as well as to all participants. Regarding the Wiki statistics on own overwrites of other people’s parts (and vice versa: parts of the learner overwritten by others), the share of the final result, frequency and size of own contributions as well as the most actively worked on pages are planned. A group can there be derived from who worked on the same parts extensively as well (obviously interested in the same topic) and from the overwriting/being overwritten statistics.

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