Collaborative Student Modelling- a new perspective using Wiki.

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Abstract: The current paper discuses the potential use of Wiki as an environment for the formation of student models during distance education sessions. The idea of student models is not novel, rather their benefits in distance education. Wiki has already been used in a number of Education scenarios and projects, either as an authoring or a teaching tool. The paper discusses the appropriateness of Wiki towards a new adapted role, that of collaborative Student Modelling and explores the possible benefit for instructors of using Wiki under that perspective. The up growth use of Wiki environment, signals the culmination of variety collaborative activities in the field of distance education.

Key-Words: Wiki, Student Models, collaborative Student Modelling, Distance Education

1 Introduction

A variety of definitions are available in literature regarding Student Models. According to Barr et al, "Student Model represents student understanding of the material to be taught with the purpose to make hypotheses about student's misconceptions and suboptimal performance strategies" [3]

Jim Greer illustrates, the different interpretations that a Student Model may have, by indicating that such model may be:

a. An abstract representation of the learner.
b. Teacher's conceptualisation of a learner.
c. System's beliefs about the learner.
d. System's beliefs about the learner's beliefs and skills.
e. It may include history of learner actions (raw data)
f. Interpretations of raw data.
g. Explanations of behaviour [6].

According to Anderson, Corbett and Koedinger there are actually two types of student modelling, *knowledge tracing* and *model tracing* [1]. These are their names for the particular techniques they used; however, the distinction is somewhat general. Knowledge tracing refers to the problem of determining what students know, including both correct domain knowledge and robust misconceptions. Model tracing refers to tracking a student's problem solving approach as the student works on a problem. Model tracing is useful for systems that attempt to answer requests for help or to give unsolicited hints and feedback in the middle of problem solving. To be adequate in assisting, hinting and assessing an on-going solution attempt, a system has to understand at a minimum level what line of reasoning the student is attempting to pursue.

On the other hand, knowledge tracing is useful for making longer range pedagogical decisions, such as what problem to assign next or what evaluation grade to assign to the student

Employment of Student Models as a valuable tool for instructors is not a new idea. Several different uses of Student Models had been reported in the literature [8], [12], [14], [22]. When it comes to distance Education, student models mean to help the teacher to achieve more effective educational sessions, rather than to act as monitoring and diagnosing tool for the simulation of a virtual tutor. The Student Model act as an intermediate communication component between the tutor and the students, recording the tutor's suggestions and feedback

regarding the students' progress in addition to the comments made by the students regarding their personal problems or the misconceptions occurred [21]. This new adopted role of Student Models in distance education has raised the issue of opening the access to them, also by the students and the teachers, for inspection and tuning reasons [11]. The so called Open Student Model [12] requires by its definition, the collaboration among students and tutors in order to negotiate and modulate its scheme. A lot of researchers from Suzan Bull [5] and J. Kay [9] to Zapata-Rivera and Greer [24],[25] allegated that, opening the Student Model to students/tutors can encourage the learner reflection, as the awareness about what have been mastered or not, and therefore enhance the learning process.

Though a lot of research has been dedicated to open student models to the students, few researches have been dedicated in opening them to tutors [24]. According to Mazza, "If the open student model has demonstrated to enhance the learning process for students, it's likely to be the same for the tutoring process" [11]. That issue of collaboration among tutors in order to form Student Models leads to Wiki environment as a potential collaborative tool in their hands.

2 Wiki, a new tool in the field.

The Wiki technology relies to the philosophy of web sites that are freely editable by anyone who visits them. This technology was invented by Ward Cunningham in 1995. The idea behind such sites is to create truly communal repositories of knowledge where the contribution cost is so low as to allow novice and expert users alike to act as active members of a community.

According Lamb, Wiki is applied to a diverse set of systems, features, approaches, and projects [10].

This open editing environment is powerful and problematic at the same time, depending on the identity of collaborative users identified as valuable contributions or vandals.

Lamb states that, "Wikis work great as shared online sketchpads or as spaces for brainstorming. They are perfect for creating perpetually updated lists or collections of links, and most users can instantly grasp their utility as informal bulletin boards". Some other uses of Wikis includes common formation of meeting agendas, course management system authoring environment (so that design teams can quickly and collaborative brainstorm instructional strategies, capture suggestions etc), and also as a support for collaborative experiments in composition and as a prompt for reflection on the nature of online writing and reading.

Among the most commonly reported phobias regarding the use of Wiki is that "If anybody can edit my text, then anybody can ruin my text". Although that such argument seem to be true, some safety keys have been consider in order to minimize that risk. Wikis save copies of successively edited versions; thus, work that has been deleted or defaced can be easily recovered. All the changes are readily detected and e-mails or RSS (Rich Site Summary) alerts in addition with IP tracking facility are also available to the administrator. Clay Shirky successfully argues that "A wiki in the hands of a healthy community works. A wiki in the hands of an indifferent community fails. The software makes no attempt to add 'process' in order to keep people from doing stupid things." [19]. Its therefore obvious that easy way of collaboration is the source power of Wiki environment. This particular characteristic may be the core of collaborative Student Model development process, among the Wiki tutors.

3 Why Wiki and not some other collaborative tool?

In order to answer the above mentioned question, a short description/comparison of the most popular tools such as Forums, Blogs and RSS will follow [2], [15], [20].

Setting up Forums is a well known practice in Internet environment since they tend to be highly interactive and vivid. Discussion Forums are best for outlying the common sense on a social or education or any kind of issue which requires debate. Beyond their vividness, they tend to be chaotic after a number of postings and very difficult to read. Valuable information can be easily bypassed if it is reported in a 4^{th} level nested posting. Forums are also bad for

document collaboration of any sort, since it's quite difficult to create anything definitive from an unsorted discussion threads.

Blog or Weblog is a newsletter or a journal that is frequently updated and intended for general public consumption. Can be used to allow a single author to post an entry or new evidence and allow an end user to comment on it. Some reasons of using Blogs are to keep the potential readers up to date on current issue or event and provide information, new launches, etc. Blogs can also act as an additional motivation for a potential reader to return to a site in order to add some comments, and therefore increase the readability of the current site.

RSS -Rich Site Summary are web feeds that allow Internet users to subscribe to websites. They are typically sites that change or add content regularly. To use this technology, site owners create or obtain specialized software which, presents new articles in a list, giving a line or two of each article and a link to the full article or post. Unlike subscriptions to many printed newspapers and magazines, most RSS subscriptions are free. Information gets sent to RSS Readers as a desktop application - similar to one-way email tool. In general RSS are better than newsletters since they update instantaneously, someone can subscribe to multiple RSS sources at same time. If title is interesting, the user can click on title to see full feed of an article as html text

On the other hand, Wiki is a type of website that allows multiple users to easily add and edit content and is especially suited for collaborative writing. Since it uses open editing anyone can make edits and therefore Wikis are useful in an environment where multiple users will be collaborating on a single document or in an environment where lots of information is continually updated. Such information may include a variety of media such as text, HTML, images etc..

A cross comparison among the above mentioned tools indicates that regarding trust issues Wikis and Forums, are open to everyone where Blogs and RSS are created by one user. Furthermore permissions can be added to a Wiki, so that updates are approved before they take effect.

Regarding the number of authors, Blogs are most useful in situations where there is only one author, Wikis are most useful in situations with multiple authors where RSS makes no difference

Comparing Temporal Duration of RSS versus Blogs and Wikis, RSS feeds should only be used in situations where content changes on a daily basis like News Updates or Reports. On the contrary Blogs and Wikis can be used with any temporal duration, under the premise that the content is frequently changed by a single (Blogslike) or multiple (Wikilike) authors.

4 Wiki as collaborative tool in education sessions.

Clearly, the majority of educational systems reinforces the solitary writer as the prototype, yet outside of academia, communities are exploring new ways to collaborate, to construct knowledge, in truly revolutionary ways.

At all levels of education, the message regarding the nature of writing is clear a solo effort. Teachers usually close their classroom doors and teach as they always have: privledging individual effort. Co-teaching and collaborative projects are the exception, not the norm [13].

Although Wiki gained grate popularity in examples like Wikipedia, its use in Education has not been discussed yet in detail. Some specific Internet sites such as http://teachingwiki.org or http://writingwiki.org appeared in order to reinforce the involvement of Wiki in Education.

Teaching Wiki aspires to be a community for college-level faculty, particularly faculty teaching rhetoric and composition. The site is also used to reflect on teaching practices, cite resources and provide lesson plans.

Writing Wiki, on the other hand is intended to serve as an online home for students enrolled in writing courses.

Recently, Dirk Riehle has organized an ongoing Panel regarding Wiki Uses in Teaching and Learning during the Conference Wiki of the 2006 International Symposium on Wikis [18]

Members of the Panel discuss and compare Wiki projects that cover diverse methods and content fields. Projects include secondary,

undergraduate, and graduate level courses. They approach the ontology and pedagogy of Wiki-based educational materials drawing on cognitive and social constructivism, a theory of inquiry-based learning, and an interest in information markets and online sharing dynamics.

Most of the Panels' members have created and now study widely different implementations of Wiki usage in education that reflect a variety of instructional approaches.

Expected outcomes that include user feedback will include, reactions and satisfaction; impact on learning; impact on grade; non-obtrusive measures of usage patterns; and external measures of quality of the content generated and preserve

Furthermore, Hagit Tal and Edna Tal-Elhasid from Open University of Israel reported a project called "The Wiki-Assignment: A collaborative assignment in a WIKI environment" in order to evaluate (in one aspect) the WIKI environment as a tool for collaborative learning [7].

They designed an online collaborative assignment in a WIKI environment: "WIKIOP" (Wiki Open University) and they have called it a "Wiki-Assignment". The WIKIOP enabled collaboration by several students working on the same document. Its main advantage was its ability to save and retrieve the specific contribution of each participant to the collaborative product.

The students were asked to suggest terms and add them to the WIKI, to write definitions of the terms and to participate in a co-editing process which aimed to improve the definitions of the proposed terms, in order to create a glossary for a particular course. During this process the course moderator did not participate directly in editing the terms, but left useful annotations and suggestions in the "discussion" section.

Some of the findings indicated that Wiki was proved to serve as friendly tool for the students and the moderator. Furthermore, based on the number of uploaded terms during the semester, they found that in 55% of the cases collaborative learning took place as the students have develop a positive attitude toward the use of Wiki.

In 74% of the cases in which the moderator was involved, collaborative learning evolved, and 93% of the Students argued that the moderator's intervention encouraged active learning.

Their experiment can be easily extended in order to outline the tracing Model of the participants. Moderator or moderators could cooperate during such process of Model tracing construction, since as it is already mentioned, Model tracing is useful for systems that attempt to answer requests for help or to give unsolicited hints and feedback in the middle of problem solving.

Hagit Tal and Edna Tal-Elhasid conclude that, in the new era of online learning the emphasis not only on individualistic models of learning but also on collaborative ones is a very important step in the advancement of higher education towards new pedagogies.

Such conclusion can also be valid for the Student Modelling process itself.

5 Expected results using Wiki for collaborative student model development.

In advance of analyzing the potential results, it is critical to understand the benefit of Student Models in education along with collaborative Student Modelling process.

Eva Ragnemalm has identified that the uses of Student Models can be divided in four categories [16]:

a. Planning education: What topics are to be learned? Which are well known? Choosing exercises at the edges of the student's capacity requires knowing what is known and what is not known in a general sense

b. Planning delivery: What experiences are suitable to encourage learning of the intended topic and which previous experiences can be utilized? Assistance such as providing hints during the problem solving is based on known subjects. Sometimes new concepts must be introduced, sometimes they can be discovered or built on old ones already known requiring detailed understanding of previous knowledge.

c. Generating feedback: Feedback on performance should build on previous knowledge as well as current conditions.

Feedback concerning well-known subjects is different from feedback on subjects recently learned.
d. Remediating misconceptions: Remediating misconceptions can be done by pointing them out to the student, either by providing counter evidence or by heaving a meta-level discussion. (p. 17)
Yet another aspect that motivated the use of Student Models in education was the process of recording students' learning styles (by examining their learning speed) and their motivation to learn (by encouraging collaboration or competition with peer students).
The general achievements gained by the use of Student Models in education were the inspection and analysis of students' mental behaviour, of their reasoning and of the knowledge that was believed to underlie such behaviour

Regarding to collaborative Student Modelling process, a quick glance at the distance education sessions of any University (or other Organization) reveals that it's very often the case where tutors share the same students among different lessons. Additionally tutors, in some cases, share the same lesson with other tutors individually or as a co-teaching activity.
Therefore the critical question is "why not having the tutors to share their experience and ideas regarding the learning profile of their students?" This is very common practice in traditional education sessions where the school teachers' board meets annually (at least) to discuss issues regarding students' performance, learning abilities or difficulties etc.
The benefits of such debates are enhanced if someone expands that process to a web based environment where multicultural tutors can potentially meet and collaborate.
In a Wiki based environment such meetings can be set up as a default process. So the tutors have a simple and easygoing method to meet and co-develop Student Models.
But such process –of formal or informal – tutors' meetings and exchanging ideas is really a part of Student Modeling process? Why to have Wiki as the basis of such development and not a simple web chat/conference session?
To provide an answer, someone has to identify the elements of Student Modelling procedure. Raymund and Masamichi, indicate three essential elements of student modelling: the student behaviour, and the background knowledge and the student model.

Student behaviour refers to a student's observable response to a particular stimulus in a given domain, that, together with the stimulus, serves as the primary input to a student modelling system. This input (i.e., the student behaviour) can be an action (e.g., writing a program) or, more commonly, the result of that action (e.g., the written program).

Background knowledge is comprised of the correct facts, procedures, concepts, principles, schemata and/or strategies of a domain -called theory- and of the misconceptions held and other errors made by a population of students in the same domain – called bug library.

Student model is an approximate, possibly partial, primarily qualitative representation of student knowledge about a particular domain, or a particular topic or skill in that domain, that can fully or partially account for specific aspects of student behaviour [17].
Tutors can use Wiki in order to provide a space for free writing, or to debate course topics including assigned readings, require students to collaborate on documents such as an essay written by the entire class or to discuss curricular and instructional innovations [23].
Wiki environment has the ability to save copies of successively edited (by students) versions of document in a very easy and simple way. Therefore, valuable data regarding Students' behaviour and Background knowledge can easily identified and retrieved via students' contributions-edits in the Wiki environment, given that such documents are easy accessible by others tutors.
Commenting those data with other tutors contributes critically in the process of Student Modelling. Tutors have the ability to argue debate and conclude to a potential report regarding students' model. These co-authored

data usually include qualitative information rather quantitative and comprise the core of Student Modelling process.
Having a single chunk of data which can be easily edit by others, it's a more convenient and manageable procedure rather than having a infinite list of nested discussion threads (usually appeared in web based chat/conferences) which are difficult to index and too complicate to interconnect in order to reach to a conclusion.
Regarding the privacy of those (confidential?) data, Wiki provides the ability of password protected workspaces, where only authorized editors are permitted to make contributions.
But what are the benefits of collaborative Student Modelling? Why do tutors have to bother?
Tutors benefits can be summarized in the following:
a. Improved class knowledge monitoring: Tutors often need to have a clear idea of the performance of their classes. This information can also be shared among other tutors in order some valuable annotations to derive. Such annotations may notify the need of altering instructional strategy or identify a particular learning difficulty on a taught subject.
b. Creating a group for collaborative problem solving essays based on the derived Student Models. The process of grouping students based on their leaning style, behavior, consideration ability becomes a more easygoing process.
c. Identification of students with some kind of irregular learning (dis)abilities. Concentration to students who need particular attention, like those that are progressing too fast or too slow with the schedule, or those that doesn't access the course for long time, or don't participate to assessment activities becomes a valuable information for the tutor [4]. If such information is also shared among other tutors, a more solid and integer profile can be schemed regarding such students.
All the above mentioned benefits combined with the Wiki environment, may be a motivation for a new kick of strike to the collaborative Student Modelling process.

6 Conclusion

Wiki has gained popularity among Internet users and is considered as the most widespread method for collaborative content development.
Educators and students have found a new playground for their activities and a number of specific Internet sites have been developed in order to reinforce and support the educational use of Wiki.
Collaborative Student Modelling process using Wiki, is a new born effort which requires time credits to prove its dynamics.
The value of using Wiki as basis for the collaborative development of Student Models, derives by its simplicity to use and the easy going processes available to the tutors willing to participate in such effort.
The built in record mechanism of revised editions, the notification process, and the handy way of retrieving information, reinforce the role of Wiki as a tool for collaborative Student Model development.
The expected outcomes of such process may contribute to the improvement of collaborative teaching, the construction of better instruction strategies, and reinforce the interaction among tutors regarding the critical issue of Student Modelling.
Teaching Wiki can also easily become for college-level faculty, a community devoted in collaborative student modelling as the reflection on teaching practices, cite resources and lesson plans is adjacent to the process of Knowledge tracing Student Modelling.
Wiki itself as a very promising collaborative environment may consider new developed features towards this aspect.
A new era in collaboration is rising from the swaddling clothes of educational community, altering Student Modelling from a solo procedure to a common effort process.

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