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Matchmaking in Learning Networks: A System to Support Knowledge Sharing

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Introduction

In its broadest form, learning networks are defined as the experiences of students and teachers with the use of computers in learning (C-SALT, 2001). More specifically, learning networks are considered to "use computer-mediated communication to support the delivery of courses in which anytime, anywhere access to interactions among the students and between the instructor/facilitator and the students are key elements" (Hiltz, Alavi, & Dufner, 2004 (p. 1); Harasim, Hiltz, Teles, & Turoff, 1995). In our view a Learning Network (LN) can be set apart from the learning networks defined earlier in that they are self-organizing and give rise to lifelong learning (Koper, Rusman, & Sloep, 2005; Koper & Sloep, 2002). This does not mean that social interaction and learning is supposed magically to occur. Rather it emphasizes that the social structures that are conducive to or even needed for learning, emerge on top of a responsive, sophisticated, yet non-imposing technical infrastructure that allows the Learning Network Users (LNUs) to develop their own preferred modes of interaction, and to guide self-organization.

In LNs, LNUs are stimulated to create their own learning activities, build their own learning plans, and share their learning activities and their plans with peers and institutions. This self-directedness, however, may easily turn into isolation. LNUs who do not feel a sense of belonging with respect to a particular LN, are unlikely to interact with their peers, i.e. are unlikely to experience even a modicum of social interaction. Similarly, LNUs who do not feel engaged or committed are less likely to initiate an interaction with others, decreasing the sociability of the network as a whole. All this could be problematic since research shows that individual success or failure on a learning activity depends on the extent to which learners perceive themselves to be outsiders or insiders of a network (Wegerif, 1998). So, without a technical infrastructure that invites social interaction and that guides self-organization within a LN, problems will arise that could hamper the academic achievement of its users.

In this paper we describe a system that matches LNUs with complementary content expertise. It works through the formation of so called *ad hoc, transient* communities. They are communities that (1) exist for a limited period of time, (2) specifically to fulfill the goal of knowledge sharing. This system supports the social embedding of LNUs in the LN and stimulates the LNUs to socially interact by sharing knowledge.

Theoretical basis of the matchmaking system for knowledge sharing

A survey of the literature (see Kester, Sloep, Brouns, Van Rosmalen, De Vries, De Croock, & Koper, submitted) yields three important conditions that should be met to enable knowledge sharing and learning in communities; we will summarise them here. First, to facilitate cooperation or collaboration in a community, clear boundaries and a clear set of rules that can be monitored and sanctioned within the community are required (the *boundary* condition) (Kollock & Smidt, 1996). Furthermore, to assure the liveliness of a community, it should be populated with a heterogeneous group consisting of, for example, veterans and newbies or lurkers and posters (the *heterogeneity* condition) (Preece, Nonneke, & Andrews, 2004). Also, for the social embedding of LNUs, one should establish recognizability of users, a historical record of actions, and continuity of contact (the *accountability* condition) (Kollock, 1998).

The boundary condition

To meet the *boundary* condition, ad hoc, transient communities should have a clear goal. Usually, this is triggered by a request of a LNU, for example, a content related question. The goal forms the incentive for the process of knowledge sharing. Indirectly this goal strongly influences the amount of social interaction during knowledge sharing within the community. Clearly, a goal that can be reached by only one correct solution will elicit less

social interaction than a goal that can be reached through various solutions. Different interaction-structures can be implemented to mediate the effects of a goal on the social interaction. For example, if the goal of the ad hoc, transient community can be reached by a limited number of solutions then a peer-tutoring structure could stimulate social interaction. King, Staffieri, and Adalgais (1998) advocate a three-step structure that consists of communication guidelines (i.e., listening, encouraging and giving feedback), an explanation procedure (i.e., the TEL WHY-procedure; telling in one's own words, explaining why and how, and linking of content), and questioning guidelines (e.g., asking comprehension questions or thinking questions). Other examples of structuring interaction within groups are "...'Group Investigation' (Sharan & Sharan, 1992), 'Student Teams Achievement Division' (Slavin, 1995), 'Jigsaw' (Aronson & Thibodeau, 1992; Bielaczycs, 2001), 'Structural Approach' by Kagan (1994)) (each structure is a scenario to teach specific skills and, although not likewise articulated, it is implicitly assumed that no situation is identical), 'Progressive Inquiry' (Rahikainen, Lallimo, & Hakkarainen, 2001), the use of scripts (O'Donnell, 1999; Weinberger, Fischer, & Mandl, 2001), scenarios that prescribe collaboration activity (Wessner, Pfister, & Miao, 1999), feedback rules or requirements of a minimum degree of contributions to a discussion (Harasim, 1993; Harasim et al., 1995)." (Strijbos, 2004; p.33). From our perspective, 'high-structuring' methods such as peer-tutoring or Jigsaw are most suitable for goals that can be reached by a limited number of solutions because they guarantee a minimum amount of social interaction. 'Low-structuring' methods such as Progressive Inquiry, however, are most suitable for goals that can be reached by various solutions because these methods support rather than elicit social interaction (e.g. negotiation, argumentation) which is believed to be necessary under these circumstances.

The heterogeneity condition

To guarantee that the *heterogeneity* condition is met each ad hoc, transient community consists of a mix of LNUs with complementary expertise, all related to the goal of the community. So if, for example, 'answering a content related question' is the goal of the ad hoc, transient community, it should consist of LNUs with different levels of expertise related to the content-question since heterogeneity in levels of expertise can have differential effects on learning. Although King and colleagues (1998) found that peer-tutors do not necessarily have to be more competent or more knowledgeable than their tutee counterparts, a study of Hinds, Patterson, and Pfeffer (2001) indicates that tutors equal in competence convey qualitatively different knowledge than more distant tutors. The near tutors - those who are similar to their tutees in expertise level - use more concrete statements during their interactions with the tutee. In contrast, the distant tutors - those with a higher level of expertise - convey more abstract and advanced concepts. Heterogeneity in level of expertise between LNUs thus leads to a wide spectrum of knowledge shared in the community.

The accountability condition

The recognisability of users is assured by forbidding the use of aliases such as screen names; this seems a reasonable demand to make in the context of a network devoted to learning. If one does not want to be this strict, users that go by a pseudonym should adopt one and only one persistent pseudonym, i.e. a singly pseudonym they keep throughout their membership of the LN and use in all interactions.

A historical record of user activities is maintained by logging all LNU-activities. The ones most significant for knowledge sharing - activities that reflect content competency and sharing competency - become part of the LNU's e-portfolio. Content competency reflects the LNU's mastery of the content within the LN. Hereto, the e-portfolio contains the products that resulted from the learning activities of a LNU (i.e., papers, reports, assessments). Sharing

competency refers to the ability of a LNU to satisfactorily support peers during a process of knowledge sharing. This information could be acquired by letting LNUs rate each other's performance in the ad hoc, transient communities. The e-portfolio also incorporates this information. To enhance individual accountability (Slavin, 1995), both content and sharing competency of a LNU is made visible to the members of a particular ad hoc, transient community (there seems to be no reason to stigmatize a person at this stage by making it always available within the entire LN). For the same reason, rating should not be anonymous, at most singularly and persistently pseudonymous.

Continuity of contact during the ad hoc community's short lifetime is guaranteed by the interaction-structure that is implemented in them (see the boundary condition). Furthermore, these communities continuously surface in the LN to serve different purposes and although they continuously change with regard to composition, LNUs are likely to meet again.

The matchmaking system for knowledge sharing

The primary goal of the matchmaking system is to identify matching LNUs so as to populate the ad hoc, transient communities as a reaction to a particular LNU-request for knowledge sharing. It should be a web accessible (for easy access) and modular (for easy extensibility) system. For the latter reason, open source systems are preferable. The system consists of three functional units: the request module, the population module and the community module, all supported by a database (cf. Figure 1). The database contains learning content (e.g., documents) organized in courses, LNU information (e.g., completed courses, current courses, activities, calendar) and output of, among others things, the matchmaking system.

The following standards are adopted in the matchmaking system: Learning Information Package (LIP) that assures the interoperability of student information between e-learning environments and Content Packaging (CP) that guarantees the interoperability of content information between e-learning environments. When possible, Learning Design (LD) that standardizes learning 'workflows' will be adopted to make sure that the knowledge sharing process is independent from the e-learning environment.

<< about here figure 1 >>

The request module

Modular Object-Orientated Dynamic Learning Environment (MOODLE; <http://www.moodle.org>) is used for the request module in which each LNU can pose his or her request(s). The request module interface allows the LNU to type in, for example, a content related question, the time span in which an answer should be provided and the content the question is related to. These data are stored in the database. Simultaneously, MOODLE activates another system that uses Latent Semantic Analysis (LSA) to map the content question on the available documents in the database (Van Rosmalen, Sloep, Kester, Brouns, De Croock, Pannekeet, & Koper, submitted). The LSA-system outputs (1) correlations between the question and (fragments of) the documents in the database and (2) text fragments related to the content question. These data are also stored in the database for later use.

The population module

PHP is used to program the population module that selects suitable LNUs to populate the ad hoc, transient community. This selection process consists of four steps: (1) determine the content competency of a LNU, (2) determine the sharing competency of a LNU, (3) assure the heterogeneity of the community population and (4) determine the availability of the LNU.

Determine content competency. To determine the content competency of LNUs the most relevant documents with regard to the question are selected from the database. The document selection conditions – to wit lowest allowable correlation and maximum selectable number of documents - are set beforehand. It is determined to which course, occasionally courses, each document belongs. In addition, based on the question-document correlations provided by the LSA-system, the question-course correlation is determined. The question-course correlation either equals the maximum question-document correlation of belonging documents or the mean question-document correlation of belonging documents. From the database it is retrieved whether (1) a LNU completed each relevant course, (2) the time it took the LNU to complete each relevant course and (3) how long ago each relevant course has been completed by the LNU. These data yield a measure that indicates a LNUs course competency. For each LNU this course competency is weighed by the question-course correlation which yields the content competency.

Determine sharing competency. The sharing competency is related to the expertise of a LNU as a contributor in ad hoc, transient communities and/or to a peer-rating of his/her contribution quality. The weight of these measures is set beforehand. The sharing expertise is expressed by the relative number of contributions made by a LNU. It is calculated by dividing the number of contributions a LNU makes in an ad hoc, transient community by the total number of contributions made by all LNUs in this community. At the break-up of a community each participating LNU rates the quality of the other LNUs' contributions. A weighted combination of sharing expertise as well as the peer-rating expresses the sharing competency.

Assure heterogeneity of the community population. The heterogeneity of the community is assured by comparing the portfolio (i.e., completed and not completed courses) of the LNU that submitted the request to the other LNUs. From the database it is retrieved (1) which courses are and are not completed by the LNUs and (2) which courses are relevant for the request. LNUs who did not complete any relevant course are not taken into consideration (i.e., they are set to zero). For LNUs who did complete any of the relevant courses, the similarity between their portfolio (i.e., completed and not completed courses) and the portfolio of the requester is calculated. The more similar the portfolios of two LNUs, the more equal their level of expertise and vice versa.

Determine the availability of the LNU. The availability is related to the past contributor load of a LNU in ad hoc, transient communities and/or to the available time of a LNU. The weight of these measures is set beforehand. The past contributor load is expressed by a combination of the relative number of communities a LNU has been involved in and the peer-rating of his/her contributions in these communities. The available time of a LNU is retrieved from the database and compared to the time span in which a contribution should be provided (i.e., input from the request module). A weighted combination of the past contributor load and available time expresses the availability of a LNU.

Based on the four measures described above, suitable LNUs can be selected to populate the ad hoc, transient communities. At least two LNUs are selected: the requester, and one or more LNUs to obtain knowledge from. Although, common sense tells us that the group size of the community should not be too large (about 5 LNUs?) the cooperative learning literature does not provide specific guidelines on how to determine the optimal group size. Most of the time no distinction is made between interaction patterns for dyads, small groups (three to six members), and large groups (seven or more members) although the interaction patterns may differ (Strijbos, Martens, & Jochems, 2004). However, since the number of inactive group members (i.e. lurkers) increases as group size increases (because of the

lessened individual accountability of the group members), the effect of the increased group size on the interaction patterns of the active members may indeed be negligible (Kollock & Smidt, 1996).

The community module

MOODLE is used to host the community. MOODLE is a full-blown virtual learning environment of which for the present purposes only the communication tools are relevant (the request module is a purpose built MOODLE extension). MOODLE offers both a forum and a wiki. The strength of a forum is that it enables its users to discuss specific topics, organized in threads. So each thread covers a separate topic and the threads usually branch off in subtopics. The history of the discussion can be traced by following a thread from origin to end. A wiki enables users to collaboratively work on a specific document. Wikis allow one to follow the history of the document because they maintain a history of the edits, including their time and author.

So both tools thus can be used to trace back the history of a discussion. For the present system, however, the collaborative nature of the wiki is an important asset. Also, the opposing opinions themselves are less important than the product that resulted from them. LNUs willing to share their knowledge could do so through a forum and then would each have to write up an answer to the question asked. Subsequently, it is up to the requester to make sense of all the answers and select what suits him or her best. Interaction with the LNUs providing the answer can only be done through commenting in the threads. In a wiki, however, the LNUs answering the question comment by editing each others answers. Thus they will arrive at the best answer as a collective. The LNU asking the question now does not have to filter the disparate information offered in the various threads, but can focus on one single answer. He or she can still comment, but it is also possible to rephrase the original question and even reformulate the answer in order to find out whether it was understood properly. So a wiki is to be preferred because the filtering of the information that is shared with the person who asked the question is done by those who share themselves. And clearly, they are in a better position to do so than the person asking the question.

Discussion

We have discussed the design of a system for asymmetrical knowledge sharing in a LN. The specifics of the design were based upon a careful consideration of the extant literature and were set out to meet the boundary condition, the heterogeneity condition and the accountability condition to assure the thriving of the ad hoc, transient communities.

Experiments are planned to establish the feasibility of the overall design. Our first experiments will focus on peer tutoring as one specific kind of knowledge sharing (the boundary condition): “Does a peer-tutoring structure fit the knowledge sharing goal ‘answering a content related question?’” and “Does a peer-tutoring structure put the knowledge sharing process on a higher plane?”. Subsequently, we will take a closer look at the composition of the ad hoc, transient community to facilitate knowledge sharing (the heterogeneity condition): “What is the optimal group size for an ad hoc, transient community?” and “Does a mix of community members with different levels of expertise indeed lead to a wide spectrum of knowledge shared by the community?”. Next, experiments will be carried out that focus on learner-representations in the LN (the accountability condition): “How do we guarantee the social presence of LNUs in the LN?” and “Does an e-portfolio that contains the history of content competency and sharing competency provide enough information to assure accountability?”.

The results of these experiments will allow us both to optimize the present infrastructure and to inform our considerations of how to use the infrastructure for other, more

generalized knowledge sharing activities.

References

- Aronson, E. & Thibodeau, R. (1992). The Jigsaw classroom: A cooperative strategy for an educational psychology course. In J. Lynch, C. Modgil, & S. Modgil (Eds.), *Cultural diversity and the schools* (pp. 231-256). Washington: Palmer.
- Bielaczycs, K. (2001). Designing social infrastructure: The challenge of building computer-supported learning communities. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning: Proceedings of the 1st European conference on computer-supported collaborative learning* (pp. 106-114). Maastricht: Maastricht University.
- C-SALT (2001). *Networked learning in higher education*. Retrieved 01/06/2005 from <http://csalt.lancs.ac.uk/jisc/>.
- Harasim, L. (1993). Collaborating in cyberspace: Using computer conferences as a group learning environment. *Interactive Learning Environments*, 3, 119-130.
- Harasim, L., Hiltz, R., Teles, L., & Turoff, M. (1995). *Learning Networks: A field guide to teaching and learning online*. Cambridge: MIT Press.
- Hiltz, S. R., Alavi, M. and Dufner, D. (2004) *Asynchronous Learning Networks ("ALN's") for E-Learning: Priorities for Future Software Development*. Panel Discussion, Conference on Human Factors in Computing Systems, Special Interest Groups (SIGs), SIGCHI ACM, April 24-29, Vienna, Austria.
- Hinds, P. J., Patterson, M., & Pfeffer, J. (2001). Bothered by abstraction: The effect of expertise on knowledge transfer and subsequent novice performance. *Journal of Applied Psychology*, 86, 1232-1243.
- Kagan, S. (1994). *Cooperative learning*. San Juan Capistrano: Kagan Cooperative Learning.
- Kester, L., Sloep, P., Brouns, F., Van Rosmalen, P., De Vries, F., De Croock, M., & Koper, R. (submitted). *Enhancing social interaction and spreading tutor responsibilities in bottom-up organized Learning Networks*.
- King, A., Staffieri, A., & Adelgais, A. (1998). Mutual peer tutoring: Effects of structuring tutorial interaction to scaffold peer learning. *Journal of Educational Psychology*, 90, 134-152.
- Kollock, P. & Smith, M. (1996). Managing the virtual commons: Cooperation and conflict in computer communities. In S. Herings (ed.), *Computer-mediated communication: Linguistic, social, and cross-cultural perspectives* (pp. 109-128). Amsterdam: John Benjamins.
- Koper, R., & Sloep, P. B. (2002). *Learning Networks connecting people, organizations, autonomous agents and learning resources to establish the emergence of effective lifelong learning*. RTD Programma into Learning Technologies 2003-2008. More is different. ...Retrieved 01/06/2005 from <http://hdl.handle.net/1820/65>.
- Koper, R., Rusman, E. & Sloep, P. B. (2005). Effective Learning Network. *Lifelong Learning in Europe IX*, 18-28.
- O'Donnell, A. M. (1999). Structuring dyadic interaction through scripted cooperation. In A. M. O'Donnell, & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 179-196). Mahwah, NJ: Lawrence Erlbaum.
- Preece, J., Nonneke, B., & Andrews, D. (2004). The top five reasons for lurking: Improving community experiences for everyone. *Computers in Human Behavior*, 20, 201-223.
- Rahikainen, M., Lallimo, J., & Hakkarainen, K. (2001). Progressive inquiry in CSILE environment: Teacher guidance and students engagement. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning: Proceedings of the 1st European conference on computer-*

- supported collaborative learning* (pp. 520-528). Maastricht: Maastricht University.
- Sharan, Y. & Sharan, S. (1992). *Expanding cooperative learning through group investigation*. New York: Teachers College Press.
- Slavin, R. E. (1995). When does cooperative learning increase student achievement? *Psychological Bulletin*, 94, 429-445.
- Strijbos, J. W. (2004). *The effect of roles on computer-supported collaborative learning*. Unpublished master's thesis, Open University of the Netherlands, Heerlen, the Netherlands.
- Strijbos, J. W., Martens, R. L., & Jochems, W. (2004). Designing for interaction: Six steps to designing computer-supported group-based learning. *Computers and Education*, 42, 403-424.
- Van Rosmalen, P., Sloep, P., Kester, L., Brouns, F., De Croock, M., Pannekeet, K., & Koper, R. (submitted). *Alleviating the Tutor Load in Learning Networks*.
- Wegerif, R., Mercer, N., & Dawes, L. (1998). Software design to support discussion in the primary curriculum. *Journal of Computer Assisted Learning*, 14, 199-211.
- Weinberger, A., Fischer, F., & Mandl, H. (2001). Scripts and scaffolds in problem-based CSCL environments: Fostering participation and transfer. In F. Fischer, & H. Mandl (Eds.), *Computer-mediated cooperative learning*. Symposium conducted at the 9th European Conference of the European Association for research on Learning and Instruction.

Figure 1: An overview of the different modules in the matchmaking system in the form of a UML activity diagram. This diagram supposes that peer tutoring is used for knowledge sharing. The enclosed parts on the top left and bottom right (i.e., line) are the request and population modules respectively, the part in the top middle is the LSA module (i.e., dotted line).

