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Multi-tiered Peer Learning Support

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Abstract. We propose a Multi-tier Learning Support Scheme (MTLS) which enables effective and scalable peer support in a collaborative online learning environment to address its inherent problem of being unstructured and undirected. The structure consists of four tiers in descendent order, namely, e-Guru, e-Experts, e-Helpers and e-Learners. At the bottom tier, peer learners help each other with their problems. When issues and problems arise at a lower level that cannot be satisfactorily resolved at that level, the next level is invoked. This project looks into the "when" and "how" of "invoking the next level" as well as pedagogical frameworks for fostering peer learning.

Keywords: Collaborative Learning, Learner-Centred Learning, Knowledge Map, Knowledge Organization, e-Mentoring, Peer Help, Peer Rating, Online Forum Discussions

Introduction

One of the problems facing e-learning is the issue of scalability of e-Mentoring support. As the number of learners increases, how can we cope with the workload on the e-Mentors? How can education service providers support a high learners-to-Mentor ratio? We propose a multi-tier learning support (MTLS) scheme with the objective to enable effective and scalable peer support in a collaborative online learning environment. Being a social and human enterprise, collaboration is inherently unstructured and undirected. We propose a framework to infuse some structure and direction.

In this paper, we propose a framework that considers the scalability dimensions for e-Mentoring support. A system that is based on this framework is implemented on a portal software called Plone (http://www.plone.org).

1. Multi-tiered Learner Support

E-Learning courses often face three common difficulties: (1) High learner-to-mentor ratio, resulting in insufficient e-Mentor assistance; (2) e-Mentors may lack understanding of learner context causing extra “roundtrips” of clarifications; (3) repetitive questions from different learners that decrease the efficiency of the e-Mentor.

The MTLS structure consists of four tiers in descendent order: (1) e-Guru ("official" e-Mentors and perhaps excellent learners); (2) e-Experts (very “good” e-Helpers who may be promoted from tier (3)); (3) e-Helpers ("good" e-Learners who may be promoted from tier (4)); (4) e-Learners ("ordinary" learners). At the bottom tier, peer learners help each other with their problems. When problems arise at a lower level that cannot be satisfactorily resolved, the next level is invoked. This project looks into the "when" and "how" of "invoking the next level" as well as pedagogical frameworks for fostering peer learning.

We propose a hierarchical peer-to-peer learning framework, more specifically, multi-tiered learner support or MTLS, to tackle these problems. The framework is not to

eliminate e-Mentors. Instead, it echoes the "seminar model" of online learning as proposed by [1] where the e-Mentors encourage substantive interactions among the participants by monitoring and shaping conversations with targeted interventions. Our framework consists of the following elements: (1) Categorization of topics and skills; (2) Rating of a user's competency; (3) Rating of a message/reply; (4) Reward scheme for forum participations; (5) An economy of peers helping each other.

1.1 Categorization of Topics and Skills

The collaborative learning model of the MTLS is based on the constructivist learning approach. However, learning by participation, reflection and self-directed knowledge discovery is often hampered by inefficiencies due to lack of centralized control [2, 3]. We have applied the Knowledge Organization (KO) approach to help in the management of evolving communal knowledge. The approach uses a core set of resources to provide the context for generating peer interactions, offers a promising strategy for addressing these shortcomings [4, 5].

We propose "courselet", a model that is based on KO techniques and represents a personal concept map comprising structured views of new and existing learning artefacts from tutorial pages and essays to discussion threads. These, in turn, can be repurposed by other learners to create their own courselets. This degree of personalization is key to KO and forms the backbone for contextualizing all collaborative interactions in our system.

The spirit of KO is to facilitate building alternative access structures by repurposing existing interactions and resources. This provides personalized and more efficient access paths. Courselets are a manifestation of such knowledge structures in our portal. Critically, repurposed conversation fragments are not embedded by duplication but by reference. This allows views of such interactions to be updated as they evolve.

1.2 Rating of a User's Competency

In MTLS, the major mechanism for assessing individual students is forum message rating, which could be extended to other types of online activities and learner contributions. This is also addresses the potential "noisy map" problem due to the availability of multiple perspectives. Essentially, learners are encouraged to rate each of their peers' postings in the scale of 1 (poor) to 5 (excellent), and so is the e-Mentor. Some statistical mechanism will be triggerred to determine the overall ratings of individual messages and individual contributors. Such a mechanism has the following advantages:

- Encouraging participation both in terms of contributing forum ;
- Encouraging thoughtful contributions from the learners in order to earn higher;
- Letting peers handle their questions to reduce load on higher-ranked participants;
- Sieving out noise by filtering out lower rated threads;
- Highlighting highly-rated messages or threads for discovery of deeply-discussed issues;
- Being used as data for assessment.

To determine the overall rating of a forum message, we apply the following formula,

$$R_{message} = (W_{e\text{-}Mentor} * R_{e\text{-}Mentor} + \sum(W_{learner} * R_{learner})) / (W_{e\text{-}Mentor} + \sum W_{learner}) \quad (1)$$

where $R_{e\text{-}Mentor}$ and $R_{learner}$ are ratings (1 – 5) given by e-Mentors and learners to the message respectively, and $W_{e\text{-}Mentor}$ and $W_{learner}$ are the ***reputation ratings*** of the e-Mentor (by default = 5) and individual learners respectively. That is, instead of taking the simple average of all the ratings, the ratings given by individuals are weighted according to the raters' reputations (that, ideally, reflects their degrees of competency as well).

To compute the reputation rating of a learner based on the ratings she has earned across all her postings, we apply True Bayesian Estimate.

A's Weighted Reputation Rating $WR_A = (Q_A * R_A + 1 * Q_{mean}) / (Q_A + 1)$ (2)

where R_A = average message rating of learner A across the entire forum
Q_A = quantity of learner A's postings
Q_{mean} = mean quantity of personal postings among all posting learners

True Bayesian Estimate factors in both message quantity and quality of a student. The higher the relative quantity (with respect to Q_{mean}) of postings from a learner, the higher one's WR will be. Therefore, a learner who has posted just one excellent message (rating = 5) in the forum will not get a WR of 5 even though the simple average of her message ratings is 5. One's WR will be pulled down due to extremely low quantity of postings.

1.3 Reward Scheme for Forum Participants

There are many difference means in rewarding individual learners who excel in quality and quantity of postings. The most important means that is associated with our multi-tiered support mechanism is to promote them to higher competency labels (learner → helper → expert → guru) according to individuals' reputation ratings, thus building up the multi-tiered learner hierarchy. For example, the minimum reputation rating needed for a learner to be promoted to a helper, an expert and a guru is 3, 4 and 4.75 respectively. On the other hand, higher ranked learners who are unable to maintain their fine performance on the forum might be demoted. This scheme relies learners' desire to be highly ranked.

1.4 An Economy of Peers Helping Each Other

Another mechanism that we intend to explore is the economy system in the learning community. Each time a learner answers a peer's question or responds to a message, (s)he earns some points. The points could be accumulated and used in real-life, for example, (1) converted to real grades; (2) used as a basis for promotion to higher competency labels; (3) earning credits that can be accumulated to enroll in future e-Courses.

Additionally, more sophisticated socio-economic or business models could be implemented. For example, in a bidding system, a learner posts a question with a number of points. Learners who are willing to offer help may bid to answer the question for a number of points (supposedly lower than the enquirer's offer). The enquirer would then choose a "supplier" among bidders in terms of the points quoted by individual bidders and their reputations. Upon the completion of the "supplier's" service, points will be transferred from the enquirer's account to the supplier's one.

We envisage that such a bidding system could achieve the aims of boosting peer helps and balancing "workload" among strong learners in peer help. For example, highly reputable and henceforth heavy loaded (and "rich" in points earned) learners may choose not to bid for answering simpler questions with lower "payment" of points associated, thus increasing the chances for other lower ranked but confident learners to win the bids.

2. Related Work

Most of the related prior research projects have been focusing on student-to-expert or peer help matchmaking. Student & User Modelling System [6], for example, maintains a student model (competency model based on peer feedback) and a user model (indicating the availability for assistance) for each student in order to recommend peer helpers and

partnerships among students. Expert Finder [7] utilizes intelligent agents to mediate expert finding and information exchange with automated knowledge classification and query formulation. Some other relevant projects are ReferralWeb [8] and Yenta [9].

The afore-mentioned systems act as a "broker" by means of user modeling of individual learners and do not concern about the expert/peer help activities after a pairing is done. Our MTLS aims to boost and mediate peer help within a learning community by means of knowledge orchestration and peer rating.

The project most similar to our work is probably I-Help [10], networked learning environments with users, learners and applications are represented by autonomous social agents that communicate, cooperate, and compete in problem solving activities, i.e., locating resources (both online and human) that are particular to a learner's help request. An economy system, similar to ours, has been incorporated into I-Help except that they make use of the mechanism to facilitate system-mediated matchmaking.

3. Conclusion

Our work on the MTLS framework is an attempt to boost and organize online collaborative learning. Possibly the first online learning framework that unites knowledge orchestration (to get collaboratively-constructed knowledge organized) and peer help scheme (to reduce e-Mentors' workload and encourage sharing of alternative viewpoints), we argue that MTLS has the benefits of devising learning-related activities with sufficient depth and creating new knowledge by learner participations. Apart from that, a richer, more vibrant learning experience will be fostered, thus increasing the satisfaction of individual learners.

There are still limitations and research questions to be tackled in our work. Firstly, the ease with which such maps (courselets) are created is important in encouraging wide-spread adoption. The current user interface is straightforward (not shown) but additional affordances can be added to simplify the creation process. Secondly, the lack of integrated cross-referencing mechanisms between knowledge maps may deter some participants from creating multi-map artefacts that offer additional means to analyse and synthesise knowledge central to knowledge organisation. What are the indicators that are worthwhile for an e-Mentor to intervene? We will address these issues in a subsequent update and undertake a thorough field study.

References

[1] Collison, G., Elbaum, B., Haavind, S., & Tinker, R. (2000), Facilitating Online Learning: Effective Strategies for Moderators, 34-39, Madison, WI: Atwood Publishing, ISBN 1-891859-33-1.

[2] Wilson, B. & Ryder, M. (1998). Distributed learning communities - an alternative to designed instructional systems, http://carbon.cudenver.edu/~bwilson/dlc.html.

[3] Penuel, B., & Roschelle, J. (1999). Designing learning: Cognitive science principles for the innovative organization. Designing learning: Principles and technologies (SRI paper series). SRI Project 10099.

[4] Looi, C.K., & Ong, E. (2003), Towards knowledge organization in collaborative learning environments, Proceedings of ICCE'03.

[5] Ong, E., Looi, C.K., & Wong, L.H. (2004), From knowledge maps to collaborative interactions, Proceedings of ICCE'04.

[6] Bull, S. (1997), A multiple student and user modeling system for peer interaction, In: Schaefer, R., & Bauer, M. (Eds), Proceedings of ABIS'97, Universitaet des Saarlandes, Saarbruecken, 61-71.

[7] Vivacqua, A., & Lieberman, H. (2000), Agents to assist in finding help, In: Proceedings of CHI'00, 65-72.

[8] Kautz, H., Selman, B., & Shah, M. (1997), ReferralWeb: Combining social networks and collaborative filtering, In: Communications of the ACM, Vol.40, No.3, March 1997.

[9] Foner, L. (1997), Yenta: A multi-agent, referral-based matchmaking system, Int'l Conference on Autonomous Agents'97, Marina del Rey, CA, 1997.

[10] Greer, J., McCalla, G., Vassileva, J., Deters, R., Bull, S., & Kettel, L. (2001), Lessons learned in deploying a multi-agent learning support system: The I-Help experience, Proceedings of AIED'01, San Antonio, 410-421.