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Do *Wikis*[⊗] Lead to Knowledge Sharing and Better Outcomes from Group Processes? – An empirical Investigation

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Abstract

Over the last two decades, the academia has engaged in intense research in trying to understand the mechanics of group processes and how computer supported collaborative work could be used to enhance knowledge acquisition, assimilation and sharing for increased and better quality of work group outputs in group settings. In recent years, wikis have become quite popular in collaboration activities, particularly in collaborative writing. In this research, we examine some theoretical propositions generated from past research on computer supported collaborative work to study the role of wikis. We found support for the proposition that in usage of wiki, a web-based collaborative tool, with anonymous participation, non-recognition of individual participation in the reward structure will lead to lower participation and inappropriate usage of the tool by the group as a whole, thus negatively impacting knowledge sharing and learning within the group. We also found support for the proposition that usage of wiki with non-anonymous participation, recognition of individual participation in the reward structure will lead to higher participation and more appropriate usage of the tool by the group as a whole, positively impacting knowledge sharing and learning within the group. Findings from analysis only provide some mixed support for our propositions in respect of quality of information and knowledge assimilation in mandated and voluntary settings. Our study has shed some light on the nature of participation of individuals in large and small groups and the outcomes of such participation of a collaborative project in mandated and voluntary settings using wiki which would motivate researchers to conduct further study on the effective use of computer supported collaborative work tools (such as wiki) for enhancing knowledge sharing and productivity in collaborative teamwork.

Keywords: collaborative work, knowledge sharing, group support

[⊗] A wiki, (quick in Hawaiian language), is a server application that lets users freely create and edit Web content. Content created by a wiki are called wiki pages. Wikis facilitate informal authoring/co-authoring using a simple text editor. History of changes is maintained as different versions and each version also identifies the author. Wikipedia (www.wikipedia.org) is one of the best examples of content, hundreds of thousands of articles in different languages, created through collaborative editing by its readers since the beginning of 2001.

1. Introduction

"The new world of work is one in which people voluntarily come together and find each other as workmates based on a common personal philosophy, social attitudes, and shared behaviours. This is the collaborative workspace." (Grantham, 2000). This statement serves as a forerunner of our research.

Over the last two decades, the industry has expended significant efforts towards development of computer systems to increase work group productivity. Likewise, the academia has engaged in intense research in trying to understand the mechanics of group processes and how computer supported collaborative work could be used to enhance knowledge acquisition, assimilation and sharing for increased and better quality of work group outputs in group settings. A broad spectrum of research and development has emerged in this area under the common name of Groupware that includes group support systems, group decision support systems and computer-supported collaborative work.

Applications arising out of these efforts included concurrent multi-user authoring systems, computer conferencing, integrated computer/video meeting systems, electronic voting, brainstorming, and workflow systems. Increasing contact with others, coupled with the freedom that technology gives us to work anytime, anywhere, will usher in an "age of collaboration." (Grantham, 2000). There is ample evidence in this direction from the growing trend and interest in the use of collaborative tools. *In recent years, wikis have become quite popular in collaboration activities, particularly in collaborative writing.*

Collaborative tools and software are designed to make the task of working together on a document easier when members are not co-located and cannot participate at the same time in a synchronous mode. The evolution of collaborative work in the electronic era is interesting. Initially, people would email documents to each other and have a 'track changes' option turned on to indicate which of their original statements had been altered. The system had inherent deficiencies in that it was difficult to collate all versions of documents that were generated in a collaborative project. The new generation of computer supported tools allow participants to open a new 'project' in a protected intranet area restrict access to it by password and access rights mechanisms. Participants may have varying access rights to interact with the project document. Some may be allowed only to view, some only to comment, and some others to make changes. The activity is logged so that disputes of document access and interaction can be avoided.

With the advent of the Internet, there has been a proliferation of such Internet-based applications for collaborative work. Several such applications are in use. One such example is the Enter Groove software, an online collaboration tool that is fostering a growing trend in virtual work environments. It is used in a wide variety of places from small consulting firms to large pharmaceutical companies to government organizations. It is designed to facilitate complex projects; from editing a document in real-time to coordinating project management to delivering PowerPoint presentations (Warner, 2003).

In the area of systems development, VRCASE is a virtual environment based Computer Aided Software Engineering (CASE) tool that provides a 3D multi-user collaborative software modeling environment. It allows multiple concurrent users to model software system collaboratively (Lin *et al,* 2003).

In another such venture, a computer supported tool was used to facilitate Knowledge and Learning in Advanced Supply Systems (called KLASS project). The system focused on the automotive and aerospace sectors and aimed to develop collaborative learning in networks of suppliers. In one such network, tier one companies encouraged supplier SMEs to identify key shop floor personnel as change agents, who participated in an innovative continuous improvement learning programme. Shared learning developed across the supplier networks, benefiting operators, management, the SMEs and the tier one companies, streamlining supply and improving competitive advantage (Rhodes and Carter, 2003).

In the on-line environment, chat rooms and discussion boards have mushroomed and participation in these environments have increased in leaps and bounds. Use of Discussion Boards (the blackboard is one example) has also proliferated in the academic environment, enabling students to work collaboratively on projects and interact with the professors and other students either synchronously or asynchronously. Group project work is a common assessment component in many courses and it is aimed to induce collaborative learning by enabling group members to explore a specific topic. Students, particularly part-time students, often run into difficulties in coordinating their group work and collaborating with other group members. Although the Internet tools such as email, chat and discussion forums assist group members in the process of coordinating, their role in collaboration, particularly in collaborative writing, is limited. The motivation for this research is the usefulness of such collaborative tools in knowledge management. In particular, this research investigates the usage of an internet-based collaborative tool called Tiki-Wiki in a postgraduate course for part-time students and its impact on group processes in terms of knowledge acquisition, assimilation and utilisation in delivering the requirements of collaborative project work.

2. Theoretical Background

User satisfaction in a collaborative (group) setting has been identified as the satisfaction with the process (individual participation, participation by others, quality of final document, writing process, collaboration amongst group members) (Noël and Robert, 2004). In anonymous participation, the opportunity to assess the contribution of others in the group is lost. Individual incentive to participate, it is argued, could be affected when the contribution of others is not ascertainable and this could also affect group collaboration. Doll and Deng (2001) found that user participation was more closely associated with user satisfaction in collaborative applications than in non-collaborative applications.

The quality of the contribution from members in the group is judged by the position the contributor holds in the eyes of the individual fellow members of the group. It also has an

impact on the other group members need to communicate since the information from someone held in an esteemed position amongst the peer may be accepted as sufficient in itself, more so in a time bound collaborative work environment where the reward of the collaborative effort would be equal for all members of the group. This may reduce the amount of communication and reduce the quality of work effort, ultimately leading to reduction in quality of product. Increasing the amount of information about members of a team in a collaborative computer-mediated system may increase the group's ability to complete the task (Spring and Vathanophas, 2003).

Doll and Deng (2001) also found that user participation is more closely associated with task productivity in collaborative than in non-collaborative applications. This implies that in a collaborative setting, the focus of the group will be on task productivity. In a time bound program for a collaborating group, this could mean achieving the result (final document in a collaborative writing environment) within the time frame by using only those features of the collaborative tool that support the task. Thus, the incentive to contribute and discuss (share and assimilate knowledge) will be secondary since the primary focus and participation of the group will be based on incentive to improve task productivity. In the absence of knowledge sharing and assimilation, there will be a compromise on the quality of the output; the group would be more keen on getting the job done rather than getting quality inputs into the process through deliberation of the inputs with questions and feedback. This could lead to inappropriate usage of the features of the collaborative tool.

Thus we have the following theoretical propositions:

1. In usage of wiki with anonymous participation, non-recognition of individual participation in the reward structure will lead to lower participation and inappropriate usage of the tool by the group as a whole, thus negatively impacting knowledge sharing and learning within the group.

2. In usage of wiki with non-anonymous participation, recognition of individual participation in the reward structure will lead to higher participation and more appropriate usage of the tool by the group as a whole, positively impacting knowledge sharing and learning within the group.

Barkhi (2002) mentions that some individuals prefer Face-to-Face (FTF) mode for interaction and would feel frustrated under a Screen-to-Face (STF) mode, but others may feel very comfortable using electronic STF applications. The author evaluates the influence of cognitive style on the perception of individuals negotiating over FTF or STF communication modes since the preference of individuals for receiving information and the methods they use to process that information is a function of their cognitive styles. In a collaborative group setting, differences in cognitive styles of group members could lead to some individuals finding satisfaction with the information delivery and processing method used by the tool, thereby leading to more participation, especially if there is no restriction on the participation and the amount of contribution. This could lead to information overload that could thwart the process of Knowledge Assimilation. In an

unrestricted setting, the lack of fear of reprisals from a group facilitator or peer members may also lead to lack of concern for the quality of the inputs, that could ultimately lead to low quality outputs from the collaborative effort (the final document).

Kwok et al (2002) conducted a controlled experiment to investigate the effects of GSS on externalization of the learners' contributions in a Collaborative Problem-Based Learning (CPBL) environment. They found that learners in an anonymous GSS-supported CPBL environment externalize more initiated ideas, fewer questions, and fewer but better feedback than those in a non-GSS supported one.

Doll and Deng (2001) studied the role of user participation in a collaborative systems design tool setting and found that encouraging end users to participate as much as they want on a broad range of issues appears to be a waste of time and, perhaps, even harmful. Drawing a corollary from this observation, we argue that in a collaborative writing effort, unrestricted participation could lead to large volume of ideas that may be of low quality and that could lead to improper assimilation or low assimilation of the contents, thereby impacting the quality of the final document.

Thus we have the following theoretical propositions:

3. In usage of wiki with anonymous participation, unrestricted participation will lead to generation of more content of low quality and information overload, negatively impacting Knowledge Assimilation and output from the collaborative effort of the group.

4. In usage of wiki with non-anonymous participation, participation will be restricted (fear of reprisals from peers for low quality contributions), leading to generation of lesser information but of high value, positively impacting Knowledge Assimilation and output from the collaborative effort of the group.

3. Methodology

In order to explore the specific role and impact of Internet-based collaborative writing tools on group work, we have collected different pieces of group work completed by 43 students of a post-graduate course on e-business systems which represents a typical course where significant part of the assessment is based on group work. The background of students on using various types of Internet-based tools (email, discussion forums, chat, etc.) was collected in the first week. This group of part-time evening students broadly represents typical full-time professionals/managers drawn from different industries and different academic programmes, who usually find it difficult to meet and discuss on their group project work.

During a 13 week-long semester, students used Tiki-Wiki, (tikiwiki.sourceforge.net/), a popular open source tool from SourceForge, for completing the assigned group work. Two types of collaborative group work, produced by the students as wiki pages, are analyzed in this paper. The first type of group work involved developing a collaborative

answering of 3 to 4 questions on 9 different case studies by the entire class (large group collaboration in a mandatory setting). Students made contributions (e.g., initiating a discussion, adding certain key points, revising or rephrasing an existing answer, summarizing) to a specific wiki page assigned to each case study. Individual contributions were identified by the instructor and tutor, using the contributor information on different versions of wiki pages in addition to the contribution, for awarding points (15% of total marks). Case studies and questions were posted by the instructor or tutor on different weeks during the semester and each case discussion was kept active for a period of 2 weeks.

The second type of coursework involved presentation of a specific case study, specially answering a set of questions, assigned to different student teams (team size of 3 or 4 students). The teams were expected to develop the answers to the case questions collaboratively using a wiki page allotted for the specific case study. Any comments and/or questions raised during or after the presentation were incorporated into the answers prepared prior to the presentation. Since all members of the team were expected to contribute equally to their teamwork, no distinction was made in awarding points (5% of total marks) for contributions by individual team members.

At the end of the course, a questionnaire was used to collect experience of using wiki pages for collaborative work from all students.

The data collected from the two questionnaires and different versions of various wiki pages corresponding to different case studies are analysed here to test the validity of the theoretical propositions.

Table 1 shows the participation and experience of the students in the class and group projects. On a quick eye-balling of the data, it can be seen that the participation in Class Project (mandatory non-anonymous participation in a large group setting) was much higher than the anonymous setting (Group Project). Thus there is support for propositions 1 and 2.

However, a plot of the graph for the mandatory participation (Figure 1) shows that the initial participation was high (25) in the first project and it subsequently tapered off and stabilized at a low level of participation of only about 15 participants. This indicates that even in a mandatory setting with an incentive system for participation, there is lack of motivation to continue participating. One reason could be the relatively low marks allotted to this component of the course (15%). It is possible that higher incentive may have led to more participation over the entire duration of the semester. This may also be viewed as a support for our proposition in that the incentive scheme is a determinant of the extent of participation. Another plausible reason could be that the participants did not see any benefit in using the tool for collaborative work. This is evident from the Table 1 data where only 10 students mentioned that the tool helped in knowledge sharing and 11 students mentioned that the tool was useful. However of the 10 who mentioned knowledge sharing, only three had participated in providing contributory information to the group project, indicating that they found it useful as a Knowledge sharing tool

perhaps in the mandatory setting. Very few (only 4 students) mentioned that the tool was useful for collaborative work. Thus, lack of benefits from using the tool may have also led to low participation in the group setting.

The analysis of the contributions from the participants in the class setting (mandated setting) indicates that the tool was used for questions and feedback on contributions; hence proper usage of the tool as a collaborative tool is evidenced. This supports proposition 2.

On the contrary, in the small group setting (anonymous – non-mandatory usage), the data in Table 1 shows that the participation was much lower compared to the mandatory setting. Further analysis indicates that in group settings, the tool was used by 21 students to collaborate on the drafting of the document (improving the style of writing and the content of the final deliverable document). The tool was sparingly for exchanging ideas or comments (only 11 participated in comments). Thus there was little knowledge sharing and there is evidence of improper usage of the tool. This further supports propositions 1 and 2.

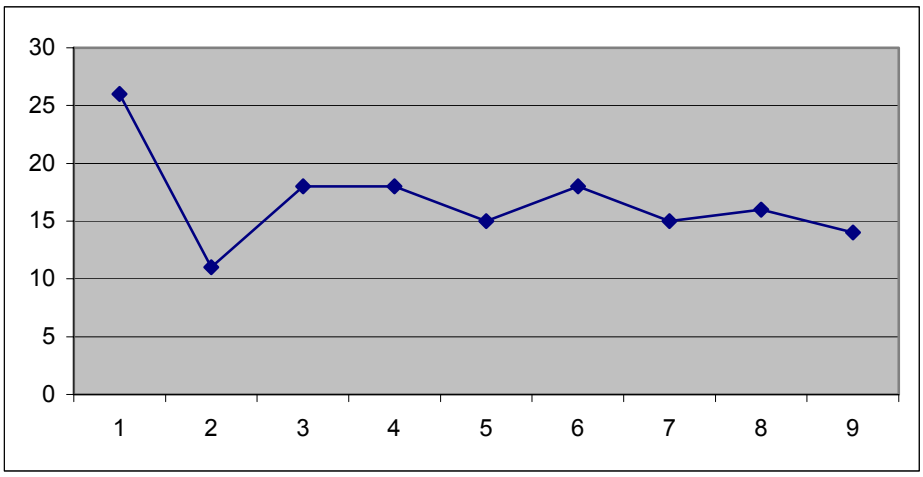

Figure 1: Number of students who participated in class projects 1 thru 9

Seven students mentioned that the answers were too long and it was difficult to keep track of who contributed what. Three of these respondents had participated in both class and group projects and hence it is not possible to identify whether the participants referred to information overload in the group settings or the mandatory class setting. However, three other respondents mentioning information overload had not participated in the group projects at all and so it is evident that they were referring to information overload in the mandated setting. Thus this contradicts proposition 4. However, this may be viewed in the context of the large number of participants in the class who participated in the class projects, that naturally resulted in accumulation of contributions from all participants over the duration of each class project. Thus it is not a direct contradiction of proposition 4; however we find no support for the proposition either. Since there was no facilitation in terms of restricting the participation, users submitted long answers to

questions resulting in problems with filtering out the right information. Restrictions may have limited the volume of information and reduced information overload. We have no evidence of information overload in the anonymous setting and hence no support for proposition 3.

Group # – Student #	Class Project Participation									Group Project Partici-pation		Wiki Experience							
	1	2	3	4	5	6	7	8	9	A	C	I	L	S	U	E	eu	C	F
G1 – S1	x			x		x		x											
G1 – S2	x		x												x			x	m
G1 – S3	x		x	x	x	x													
G2 - S4						x		x	x	x	x								
G2 – S5	x			x	x			x											
G2 – S6	x		x	x		x	x		x	x	x	x			x		x		n
G2 – S7	x		x			x	x								x				m
G3-S8				x						x	x			x			x		y
G3 – S9										x									
G3 – S10	x		x				x	x	x	x	x	x		x					y
G3 – S11			x		x					x	x								
G4 – S12			x	x						x	x								
G4 – S13		x		x			x	x	x	x			x	x	x				m
G4 – S14							x		x	x	x								
G4 – S15	x	x		x						x									
G5 – S16			x	x		x			x	x		x	x	x	x		x		y
G5 – S17						x				x									
G5 – S18								x		x									
G5 – S19						x		x	x	x									
G6 – S20	x	x	x	x	x		x	x	x	x	x		x	x			x	x	y
G6 – S21			x		x		x						x	x	x	x	x		y
G6 – S22															x		n		m
G7 – S23			x	x		x			x	x	x	x					x		m
G7 – S24	x						x		x	x									
G7 – S25	x			x	x	x	x	x	x	x				x	x		x	x	y
G7 – S26	x	x								x									
G8 – S27	x				x		x												
G8 – S28	x	x	x		x						x								
G8 – S29				x															
G8 – S30						x													
G9 – S31							x	x				x	x	x	x				m
G9 – S32	x	x		x		x	x							x	x				ns
G9 – S33	x		x		x	x													
G10 – S34	x	x	x	x	x							x							
G10 – S35	x	x			x	x	x	x	x	x					x	x			y
G10 – S36	x	x	x				x	x	x										
G10 – S37	x	x	x		x	x				x					x			x	y
G11 – S38	x							x											
G11 – S39	x			x		x											x	x	m
G11 – S40	x		x			x													
G12 – S41			x	x	x	x		x	x										
G12 – S42												x							
G12 – S43	x	x		x	x		x	x	x		x								

Legend:
Group Project: A- Answers; C-Comments.
Wiki: I - Information Overload; L-Learning; S-Knowledge sharing; U-Usefulness; E-Enjoyable; eu- Ease of Use; C-Collaboration; F-Future Usage Intention.

Table 1: Participation and experience of the students in class and group projects

In terms of the quality of the output, we find from the data that two groups (group 2 and 3) that had participated in the group discussion (both for answers and contributions) actually produced document quality that were inferior to two other groups (group 9 and 10) that had not had any group collaboration with the tool. In a comparison of two other groups (group 3 and 9) we find that the quality of the document produced by the groups were the same, though one used the collaborative toll and one did not use it at all.

Thus we find mixed support for the propositions in terms of Knowledge Assimilation from usage of the collaborative tool in mandated and voluntary settings.

4. Discussion and Conclusion

In this research, we used a natural setting to examine some theoretical propositions generated from past research on computer supported collaborative work. We found support for the propositions that in usage of wikis with anonymous participation, non-recognition of individual participation in the reward structure will lead to lower participation and inappropriate usage of the tool by the group as a whole, thus negatively impacting knowledge sharing and learning within the group. We also find support for the propositions that in usage of wiki with non-anonymous participation, recognition of individual participation in the reward structure will lead to higher participation and more appropriate usage of the tool by the group as a whole, positively impacting knowledge sharing and learning within the group. Findings from analysis only provide some mixed support for our propositions in respect of quality of information and knowledge assimilation in mandated and voluntary settings. The implications, especially from employing wikis in collaborative work, are of significance to both practice and research.

We identify certain limitations in this study related to the methodological aspects such as small set of subjects, lack of in depth analysis of actual contributions, and generalizability of the findings. Despite these limitations, we believe that an interesting scenario has been presented that sheds some light on the nature of participation of individuals in large and small groups and the outcomes of such participation in the final deliverables of a collaborative project in mandated and voluntary settings using a computer supported collaborative work tool. Future research could investigate the impact of the individual cognitive processes in group participation to gain deeper insight into individual participation in mandated and voluntary collaborative work with computer supported tools.

References

Barkhi, R., "Cognitive Style May Mitigate the Impact of Communication Mode," *Information and Management* (39:8) 2002, pp. 677-688.

Doll, W. J. and Deng, X, "The Collaborative Use of Information Technology: End-User Participation and System Success", *Information Resources Management Journal*, Vol. 14, No. 2, 2001, pp. 6 – 17.

Grantham, C., *The Future of Work: The Promise of the New Digital Work Society*, Reviewed by Anonymous; The Futurist. Washington: May/Jun 2000. Vol. 34, Iss. 3; pg. 54, 2 pgs.

Kwok, R.C.W., Lee, J.N., Huynh, M.Q. and Pi, S.M. "Role of GSS on Collaborative Problem Based Learning: A Study on Knowledge Externalization", *European Journal of Information Systems*, Vol.11, No.2, June 2002, pp.98-107

Lin, Q., Low, C.P., Ng., J.M., Bu, J., and Liu, X, "Multiuser collaborative work in virtual environment based CASE tool" *Information & Software Technology* 45(5), 2003, pp. 253-267.

Noël, S., Robert, J.-M. "Empirical study on collaborative writing: What do co-authors do, use, and like?" *Computer Supported Cooperative Work: The Journal of Collaborative Computing,* 13 (1), 2004, pp. 63-89.

Rhodes E. and Carter R., "Collaborative learning in advanced supply systems: the KLASS pilot project," *The Journal of Workplace Learning*, 1 June 2003, vol. 15, iss. 6, pp. 271-279(9).

Spring, M.B., and Vathanophas, V., "Peripheral social awareness information in collaborative work," *Journal of the American Society for Information Science and Technology* (11), 2003, pp. 1006-1013.

Warner, J., "The Miami Herald Web Strategies Column," *Knight Ridder/Tribune Business News*; Washington: Jun 2, 2003, pg. 1.