ENHANCING COLLABORATIVE LEARNING IN WIKIS THROUGH AN ITERATIVE MODEL BY SUPPORTING VARIOUS USER ROLES

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ABSTRACT

Web 2.0 paved the way for Computer-Supported Collaborative Learning (CSCL) using Wikis. However, basic Wikis have limited features in terms of catering for various roles and responsibilities of users causing hindrance for effective collaborative work among them. Hence, it is important to investigate how these varying roles can band together in a CSCL environment.This research recommends an iterative model with defined users and roles working in a collaborative environment. The study underwent a 3-week exercise, involving 16 participants belonging to the Bachelor of Information Technology program at a university in Malaysia. Data collected from these participants helped in evaluating the model proposed. Data collection techniques involved structured surveys and structured interviews to understand participants' perceptions during collaborative work (group assignment).The results gathered from the surveys were statistically tested using the non-parametric statistical test named "Wilcoxon signed-rank test".The proposed iterative model encouraged the students to be more active and responsible in the CSCL environment. Studyshowed that the inclusion of users and their roles helped in managing and performing group tasks. The research identified lists of users and roles working within the CSCL environment. The iterative model supported theseusers and roles, monitoring their progress using process checks.

Keywords: Wikis; Computer-Supported Collaborative Learning; Users; Roles; Process Checks

1.0 INTRODUCTION

1.1 Background

For many years, the Web was limited to clicking, browsing and reading only. This made the Web users passive consumers of online information. With the advent of Web 2.0, collaboration over the internet has become much easier. Today, the Web offers users to create, edit, and delete documents on an online space. In short, the Web has moved from read only to read-write Web[1]. Based on this concept, Wikis provides a collaborative environment. "Wiki", a Hawaiian word meaning "fast" or "quick", is a collection of interconnected Webpages created or edited by a group of learners. The idea behind Wiki is to present an easy to use collaborative environment where everyone is able to contribute by writing and sharing information[2]. Because of the popularity of Wikis, researchers have started to look into techniquesfor making computer-support collaborative learning possible.

Wikis have shown major improvements in meaningful learning and management as compared to the traditional collaborative approaches such as teacher-centred and pupil-centred learning environment[3-5]. This is because conventional teaching methodologyfocused more on passive activities, such as reading and listening, rather than active activities such as writing or discussions. A study conducted by Benware also shares the same result[6]. He concluded that the group selected for active orientation was more motivated to learn as compared to the other group. Moreover, they had higher conceptual learning scores, considering they had to learn the concepts before they could share it with their peers. Article by Haley discusses about the challenges faced by University of Alabama students when asked to workin team based software projects using traditional software tools with limited support for collaboration, tracking of changes and centralized storage. However, availability of open source collaborative tools such as DokuWiki, Trac and Subversion provided the basic tools when communicating and working collectively.

Students and instructors were able to perform tasks more conveniently as compared to traditional tools [7].Rongalso discussed about the difficultiesin conducting peer-revision in traditional classroom environment. Instead he suggests a Wiki-based application that is being used for peer-revision in English writing [8].

Many researchers have emphasized on the importance of Wikis and their usefulness in collaborative work. Chu highlights the potential that lies in using these systems at primary level[9]. He also proposed about introducing CSCL systems in schools and the benefits young scholars can gain from it[10]. Elrufaieconducted an experiment on IT students for developing theirWeb technology skills by providing them a collaborative environment using Wikis. Their skills improved as the platform restricted them tousing XHTML, HTML and XML only for writing content[11]. Similarly, Chen paper on how Wikis can act as a scaffolding tool in education is of the same view[12]. Article by Shu compared the use of MS Word with face-to-face collaborative writing in Wikis, which led to more participation, improved quality of content produced and increased satisfaction of users [13].Other studies and projects including[14], [15], [16], [17], [18], [19], [20], [21] , [22], [23][24]share the usefulness of Wikis for promoting CSCL environments in different domains.

1.2 Improvements required in CSCL environments

Prior research shows that CSCL environment hold the future for collaborative work. However, collaborative models such as Wikisneed improvementin order to use CSCL environments to their full potential. In most cases, the problem lies either with missing features within the model or mismanagement of human resource.

Von Hinten shares why basic Wikis are not ideal for collaborative work among researchers and what additional layers are required to be added[25]. For example, he talks about versioning that is not present in Wikis but is a necessity for researchers and their work. Valiente research also shows that Wiki systems in universities are not being used to their full potential. According to the survey conducted by his team, the students require training and more controls like ‘access control’ and ‘article monitoring’ in order to be effective. For example, student creating a new Wiki page should be able to managed userswho can read, edit, and delete the content. Moreover, they should be able to view revision history of the Wiki page which shows the changes applied by different users[24]. Tanseypaper also showed that additional support and structure is required for using Wikis in task-driven collaboration[26].

Hester also suggests an iterative model for better adaptation of Wiki technology. The model consists of different stages, where each stage compliments the previous step for proper Wiki technology diffusion. The models reiterates the processes withina stage until the achievement of satisfactory results. The focus of the research is mainly on how organizational culture, organizational compatibility, relative advantage, critical mass and complexity have a deep impact on Wikis[27]. Wang highlights four properties of traditional Wikis because of which they are not ideal for classrooms. These include ‘no concurrency control’, ‘lack of access control’, ‘issues with read/write lock’ and “no option to make the control hidden/visible”[28]. Likewise, Rong though supports the idea of Wiki for collaborative writing but he also shares that the traditional Wiki design has limitations.For this reason, the team choose a self-hosted Wiki-based application(JSPWiki) that could be modified in order to support a peer-revision environment [8].

Though Wikis provides a platform for collaborative work, one needs to address add features so it provides a CSCL environment working at its full potential. The shortcomings found in basic Wikis, used for providing CSCL environment,identified by different researchers are:

- No support for access control
- No option for viewing change log
- No option for specifying user groups such as students, instructors, support staff, etc.
- Inability to define roles and assigning them to users

Some of the customizable free, fee-based or self-hosting Wiki solutions offer features likes 'access control' and 'versioning' or allow developers to add features themselves. On the other hand, management of human resource is a different story. The benefit of working in a collaborative environment is distribution of workload among peers. However, when one is unaware of his role within the system, it can affect the efficiency of the system. Since the Wiki system is unaware of these, it will undermine the potential of the collaborative environment. Identifying users and roles within the CSCL environment would allow researchers to add features required by users in order to fulfil their roles. In addition, these systems are unaware of the requirements expected from users participating in the CSCL exercise. The system must be able to monitor and track activities of users in order to help evaluators judge whether users are fulfilling their roles or not.

1.3 Research Questions

We hypothesize that by understanding the different users and their roles within the system, one can have a better understanding on how the system should operate. By identifying these, researchers will have a better idea on the features required in the Wiki system in order to meet the organizational and user needs. For confirming this hypothesis, evaluation of a model is required that has defined users and roles within a CSCL environment.

The purpose of this study is to identify users and their roles within a university's CSCL environment. This will allow us to evaluatestudents' perception,behaviourand motivation towards Wikis by assigning them user type and their role.The research questions of interest are:

1. What arestudents'perception towards Wikis before training?
2. What are students' perception towards Wikis after training?
3. How will students respond andbehave towards Wikis after going through training?
4. How will students respond and behave towards use of Wikis with defined roles and responsibilities?
5. How will teachers respond towards the model forcollaborative work assignments?

1.4 Objectives

In order to answer these questions, two major objectives of the research have been set as follows:

- To identify users and roles for university CSCL environment for effective collaborative learning
- To propose an iterative model to ensure that the requirements of users and roles are being met

Users and roles will help in the distribution of the work as well as be able to manage the system better. Moreover, it will help researchers in defining models to support these roles for better functioning and suggest additional features. The iterative model should consist of different process checks containing parameters. These parameters will allow us tomonitor users and roles criteria at different stages, for maintaining effectiveness and efficiency of the model.

2.0 LITERATURE REVIEW

In a traditional university environment, typical users are students, teachers and support staff. This is not the case in a CSCL environment, as management of the model requires more users. Elrufaie, Rong and Zheng identified up to six different users in a CSCL environment: guest, students, instructor, tutor/teaching assistant, academic staff and technical staffas mentioned in Table 1.

In a CSCL model, "guests" are users who view data only. They are only able to view Wikis that have been completed and evaluated. Students are the authors and editors of the content produced in a university CSCL

environment. They will still be involved in course work but will be doing so using Wikis. Moreover, the students go through more group assignments where they work with their peers and review each others work. The Instructors in a CSCL environment are expected to be more active in CSCL environments than traditional models. For achieving this, tutors/teaching assistant help instructors by covering some of their responsibilities. The instructor focuses on evaluating the projects, quiz and assignments as well as conducting the course where as the tutor/teaching assistant stays online for students' questions and online face-to-face sessions. The technical staff is concerned with the proper functioning of the system with respect to software. Lastly, academic staff makes sure that the course is meeting the academic curriculum requirements [8, 11, 29].

Table 1: Users and their actions in a University Environment [8, 11,29]

Users	**Actions**
Guest	Viewing Wikis
Student	Taking courses and doing self/group assignments
Instructor	Conducting lectures and evaluating quiz, assignments and exams
Tutor	Answering student queries relating to the course
Academic Staff	Making sure academic curriculum requirements are being met
Technical Staff	Making sure the Wiki system is working properly

Besides user types, Roles in the CSCL environment are important as well. Wiki roles contribute towards creating an effective collaborative learning environment. The roles that contribute the most are authors and editors. Authors initiate the topic and provide the original content. Editors improve the material over time. Research done by Howard and his team identified four roles (in editors) that have the most impact based on the analysis done on Wikipedia[30]. These are technical editors, counter vandalism, substantive experts and social networkers as listed in Table 2. These roles help us identify the active and passive participation of roles in Wikis. An active and well-organizedWiki will have a higher percentage of authors and technical editors as compared to other types. Assigning a user to one or more author/editorstypes will increase the effectiveness of the model. These types help us understand the distribution of activities in content generation. Moreover, they can help us identify the category a student belongs to in order to take the necessary action. E.g. a student contributing less might be leaned towards "counter vandalism" or "social networker"[30].

Table 2 : Authors and Editors in CSCL [30]

Type	Explanation
Authors	Who Write the initial content
Technical Editors	Who correct style or formatting errors
Counter Vandalism	Who revert vandalism and sanction norm violators
Substantive Experts	Who actually improve the quality of the content
Social Networkers	Who support the community and may contribute to existing or new content

Guzdial, also defines a model in which he identifies different roles participating in a CSCL environment. These include authors, purpose agents, central users, peripheral users, site designers, developers, administrators and support staff. Table 3 lists the activities of these roles and the users related to them. [31].This division of roles is much closer to the university's CSCL environment, which makes it suitable for the current model.

Table 3 : Users, Roles and Activity Matrix [31]

Role	Activities	Features Available	Related Users
Authors	Add new material, link related material and manage access to the content	Editing tools for composition of content	Students, Teachers
Purpose Agents	Provide purpose and context to different activities	Navigation Support, add/remove/edit tasks	Teacher
Central Users	Organize and provide proper structure	Re-classifying material	TA, Students, Teachers
Peripheral Users	Viewing and reviewing content	Notification and comment support	Guests, Students
Site Designers	Change the user interface as required	Templates and customization support	Students, TA, Technical Staff
Developers	Add new technology/features	Access to source code, database and APIs	Technical Staff
Administrators	Manage access control, checking academic curriculum	On-line admin utilities support	Technical and Academic Staff
Support Staff	Managing maintenance and robustness of servers	Monitoring, backup and upgrade support	Technical Staff

The identification of these users and roles is useful but there is little literature on judging their effectiveness in CSCL environment. There is little research done on measuring the effectiveness of these users and roles in a CSCL environment or collecting user's perceptions and behaviour towards it. Additionally, there is a need to look into a model that supports these users and their roles in the collaborative environment.

This research looks into an iterative model that supports these users and roles in a CSCL environment and the effectiveness of this model on users participating in the study. In the next section, we will discuss about the methodology selected for collecting the data and the iterative model supporting users and roles in a university environment. The data collected will benefit researchers in understanding user's behaviour and perceptions towards Wikis using the iterative model or comparing it with other models.The model also suggest a novel way of identifying/improving features by verifying whether the various roles in the CSCL environment are able to fulfil their responsibilities using feature at hand. Lastly, this data will help researchers in designing models for other domains and implement systems based on this model.

3.0 METHODOLOGY

3.1 Participants

The study involved 16 students divided into four groups,taking "Service Engineering & Management" course for the program Bachelors in Information Technology (Majors in Management). For the exercise, each group worked on a different topic. This avoided plagiarism and encouragedthe students in writing new content. One teaching assistant was involved for the exercise. He worked alongside with instructor for smooth execution of the exercise and answer to student queries online.

3.2 Iterative Model

For this exercise, a model was required that allows evaluators to confirm that requirements to a successful CSCL environment are being met. These requirements can be divided into several stages where each stage expects certain goal to be met. West lays out the possible parameters that are required to be checked at each stage during a CSCL exercise [1]. Based on his findings, we have compiled these parameters in the form of three process checks shown in Table 4, 5 and 6. Other studies suggest similar models where the students go through several steps for making the collaborative task smooth and streamlined [8, 29,32]. Further research in the area may add additional parameters into process checks. These parameters help the instructor, tutor and support staff in making sure that the system is working as planned. Issues are resolved or identified when students are not meeting the criteria of the parameter.We propose an iterative model, consisting of process checks for monitoring fulfilment of roles and address problems. This model consists of process checks, deployed at three different stages of the exercise (start, middle and end of the proposed task). Fig.1, explains the work flow of the process checks.

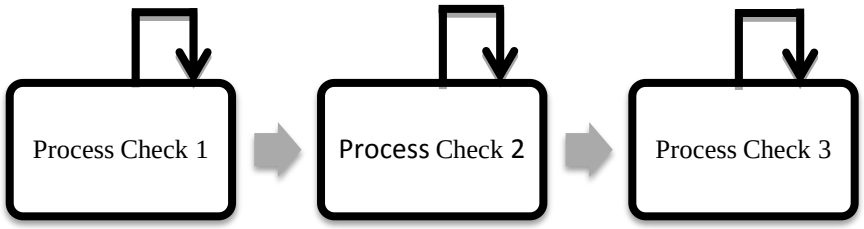


Fig. 1 : Process Checks Work Flow

Table 4 : Process Check 1 [1]

Parameter	Explanation
Preparedness	Users have enough experience with Wikis
Openness	Group members are positive towards online collaboration approach
Group Timeline	The project/assignment timeline is defined
Roles	User understand his role within the group and tasks he needs to perform

Table 5 : Process Check 2 [1]

Parameter	Explanation
Prewriting Activities	Group members are involved in brainstorming and discussion activities
Integrity of Contributions	All group members are working towards their goal as prescribed in their roles
Self-Organization	User are in touch with his group members and discusses issues if faced

Each stage consists of process checks and set of requirements. The interactive model keeps checking these requirements before proceeding to the next stage. The requirements includes fulfilment of user roles and their responsibilities. Process check serves two purposes. Firstly, to make sure that the user is on the right track and is fulfilling his role and responsibilities. Secondly, if a user is facing any difficulty, redefining the roles or adding/modifying features can address them, thus making the model incremental as well.

Table 6 : Process Check 3 [1]

Parameter	Explanation
Constructive Process	Frequent revisions have been applied to the project
Balanced Contributions	All group members worked collectively
Organization	Wiki are well written, organized, referenced and links are easily navigated
Cohesion	The final output is consistent with the requirements set

3.3 Process Checks

The process checks contain parameters for making sure that the roles are not facing any difficulties when working in the University CSCL environment. Each process check has an objective in mind as explained in detail below.

The 1st process check makes sure that the users are prepared for taking on the assignment and have made the necessary arrangements. It consists of four parameters including "Preparedness", "Openness", "Group Timeline" and "Roles". The 'preparedness' parameter confirms whether the students have the necessary training for performing the task. Provision of training is there for users new to working in a CSCL environment. The 'openness' parameter is there to check whether the participants have a positive attitude toward the environment. Sometimes, the participants are not convinced that the new environment is suitable for conducting the exercise. In such a case, highlighting features that benefit the participants can clarify these doubts. 'Group timeline' and 'rolesparameters'; have been added to check if the participants have planned the exercise with their peers. This helps students when proceeding with the assignment and distribute tasks among team members. If either one of these parameters are not being fulfilled then the participants can be given more time or training before moving onto the second stage.

The 2nd process check is conducted half way down the exercise. In this process check the prime objective is to make sure that the group members are working well as a group and each member is performinghis/herrole in the exercise. The parameters in this process check consists of "Prewriting Activities", "Integrity of Contributions" and "Self-Organization".'Prewriting Activities' is there to make sure that the group is involved in timely group discussions. Keeping group discussions online allow instructors/TA to monitor these activities. This way it became easier for TAs and instructors to make sure whether a group is actively participating in the assignment or not. The second parameter 'Integrity of Contributions' verifies whether the group members are performing their duties according to the defined roles. The roles are counterchecks with revision histories for checking this. 'Self-organization' is there to see if every member is making his/her individual effort to keep in touch and participating as a team member within the group.

The 3rd process check is conducted after the conclusion of the exercise. This process check makes sure that the assignment met the academic and CSCL objectives set out at the beginning of the assignment. The parameters included in this process check are "Constructive Process", "Balanced Contributions", "Organization" and "Cohesion". 'Constructive Process'checks whether the contributions by the students have been frequent. 'Balanced contribution' makes sure that all group members participated and contributed equally towards the assignments.

'Organization' and 'Cohesion'parameters monitors the quality of the Wikis and requirements set out by the instructor and academic staff.

3.4 Data Collection

For handling data collection,the study adopted quantitative and qualitativeresearch methodologies comprising of structured questionnaires (using Likert scale) and structured interviews. The Instructor and teaching assistant conducted the interviews at the end of each process check session followed by a questionnaire. The questionnaires contained questions with fixed responses as well as text areas where students could give their point of view if they disagreed to a question. The fixed answers to the questions used a scale of 1 to 5, starting from 'strongly disagree', 'disagree', 'neutral', 'agree' and 'strongly agree'. The interview questions related to the process checks. The purpose of these interviews was to ask questions to students in order to know about their understanding towards Wikis. Another purpose of these interviews was to understand the problems faced by the students and guide them accordingly.

3.5 Platform

There are a number of platforms to choose from for the deployment of the model. These categories include free, fee-based and self-hosting services. Each has certain limitation and advantage over the other[1]. For our experiment, we considered free-based service (Wikispaces), which consist most of the features necessary for conducting the exercise. It provides both free and fee-based solutions that covers most of the features that were necessary for conducting the exercise. These include private groups, versioning, discussion forums and access control. Moreover, the Wikispace community is quite active and offers useful content and videos for people that are new to Wikis. However, before using the system, it is required to check that most of the expected features are included in the system. These features have been compiled from different articles and are listed below[8, 11,33].

1. Teachers/Instructors should have the option to restrict modification of certain Wikis/pages such as course outline, lecture handouts and assignment details.
2. Students should have the option to make their pages private(to themselves/group members) before sharing them with public.
3. There should be an option to limit modification to the class only or making the access public.
4. If the system is capable of forming groups then it should form heterogeneous student groups.
5. The system should be able to track activities of group members in order to avoid the riding phenomenon, where students don't contribute much to the group yet are considered as a group member and are awarded marks accordingly.
6. The system should have an accurate assessment mechanism for individual student contribution. This can be done by tracking students active use (add, edit, organizing), passive use (viewing content), interaction with group members and community, survey response and previous evaluations.

3.6 The Experiment

Each group had to create a Wiki page based on a topic given by the Instructor over the span of three weeks. The teachers and TAs are engaged in this activity for monitoring progress of the students. The first process check is performed before handing out the assignment, the second check is conducted after the first week and the third check is conducted after completion of the task.In additional to these process checks, students gave their responses to structured questionnaires, which helped in recording their behaviour and perceptions about Wikis. These questionnaireshelped answer the research questions stated earlier.Moreover, each group went through structuredinterview sessions.This helped in understanding their problems relating to Wikis and get constructive feedback relating to the exercise. The students also shared their experience when working with defined roles and responsibilities.

3.7 Statistical Test

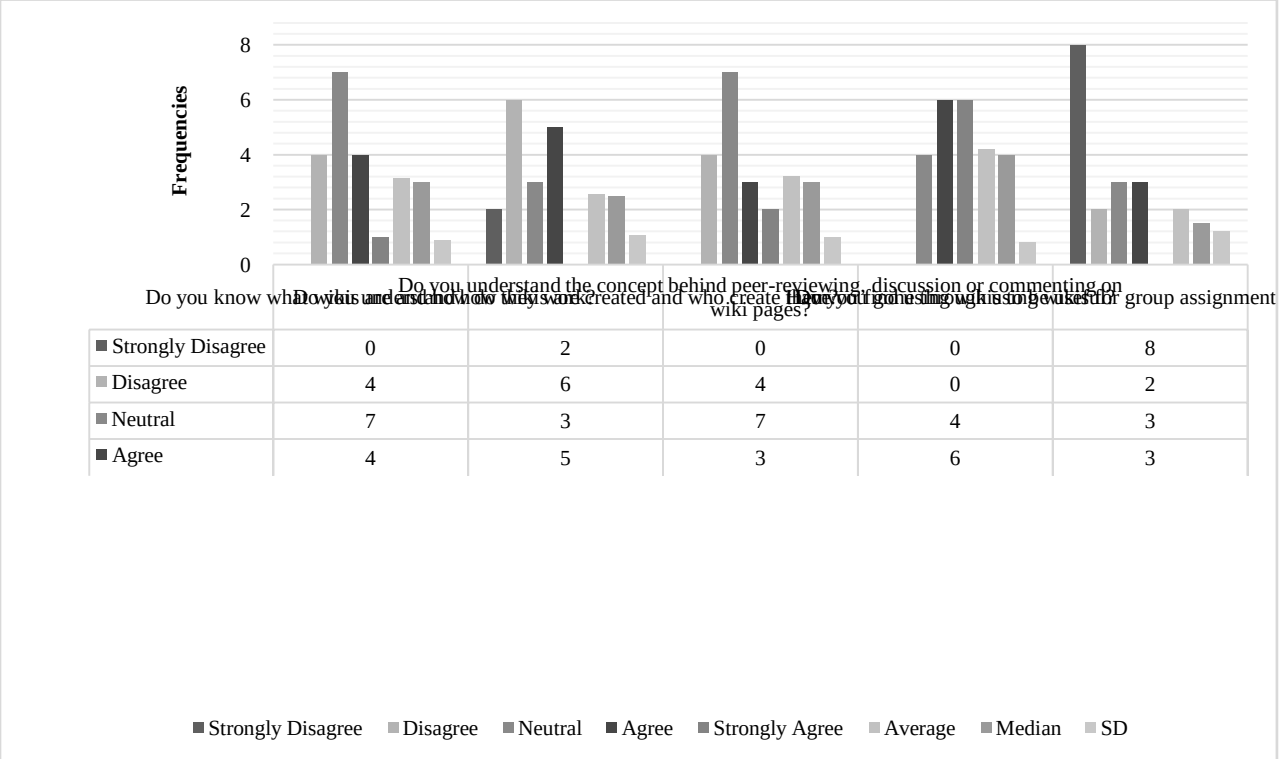
Quantitative data from structured surveys were analyzed using IBM SPSS Statistics 22. Non-parametric methods were used in the quantitative analysis due to the small sample size and the Likert scale data structure. The paired and one-sample Wilcoxon signed rank test were used for verifying the results and hypothesis. The tests begin with null hypothesis stating that the before and after results are same and is rejected if p<=.05.The null hypothesis is confirmed or rejected (depending upon the value of p) for questions falling under "students perceptions before and after training", "students behavoir towards Wikis" and "students behavoir towards using defined roles and responsibilities".

4.0 RESULTS AND FINDINGS

The exercise consisted of evaluation atthree different stages i.e. first, second and third process checks. Moreover, these process checks helped in checking the requirements set for monitoring student's progress and CSCL environment as discussed in detail below:

4.1 First Process Check

The first questionnaire asked thestudents'about their perception ofWikis. These set of questions were asked before conducting the exercise in order to judge how much they know about Wikis and whether they consider it useful or not as shown in Fig. 2.



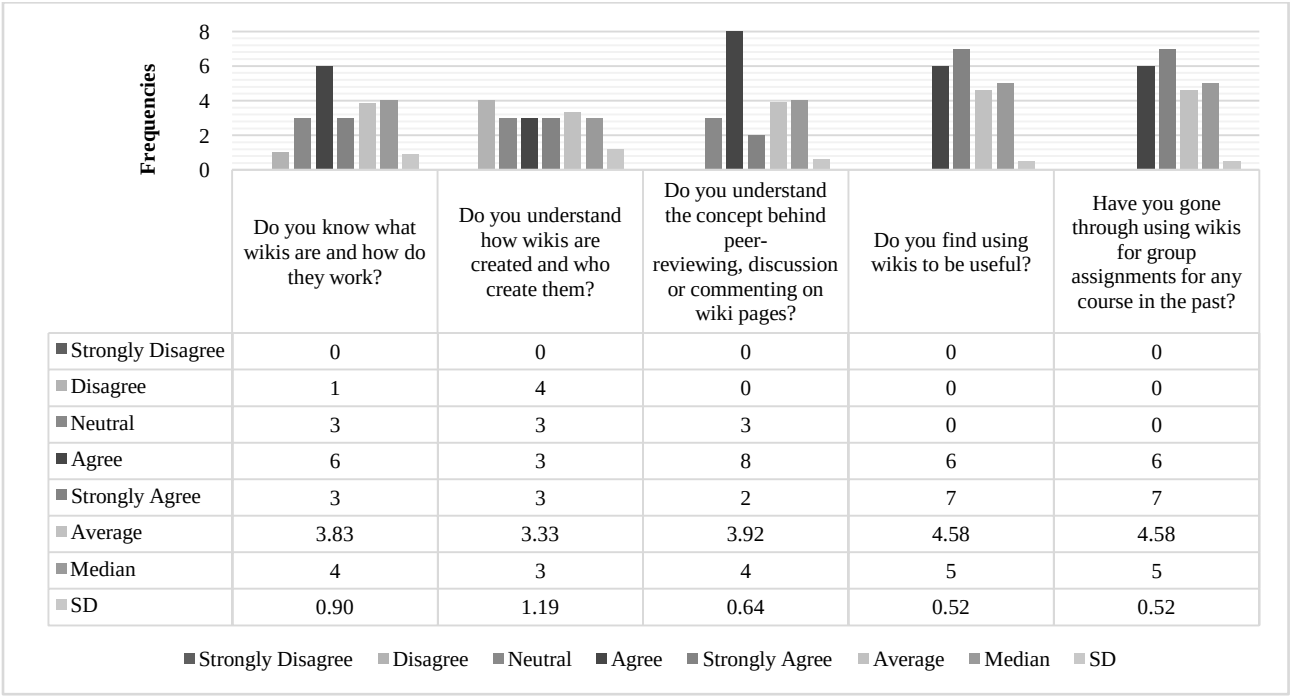
	Do you know what wikis are?	Do you understand how they work?	Do you understand the concept behind peer-reviewing, discussion or commenting on wiki pages?	Have you ever created and who create Have you ever used wikis for group assignment	
Strongly Disagree	0	2	0	0	8
Disagree	4	6	4	0	2
Neutral	7	3	7	4	3
Agree	4	5	3	6	3

Fig. 2: Frequencies of students' response to questions relating to perception of Wikis before training

The first three questions are about the working of Wikis, creation of Wikis and peer reviewing done in Wikis respectively. In these questions, most students opted "neutral" or "disagree"/"strongly disagree" options. This is because most of these students were working with Wikis for the first time or had very little prior experience. The last questions showed more than 60% of the students have not gone through using Wikis in collaborative assignments before.Some students have also answered 'neutral' to the question, this shows that these students might have gone through an exercise, which was on the lines of Wikis for doing collaborative, work. Another important observation gathered from these results was that the students were positive and found Wikis to be useful if given the necessary training. This shows that students have used information on Wikis in the past. Thus with training, students can generate useful knowledge on generating Wikis. Based on the feedback received from the first process check, we provided literature for Wikis and conducted a basic training session on Wikispaces. This training enabled students' being able to edit their respective Wiki pages, participate in discussions, review change log and use include widgets in Wikis.

4.2 Second Process Check

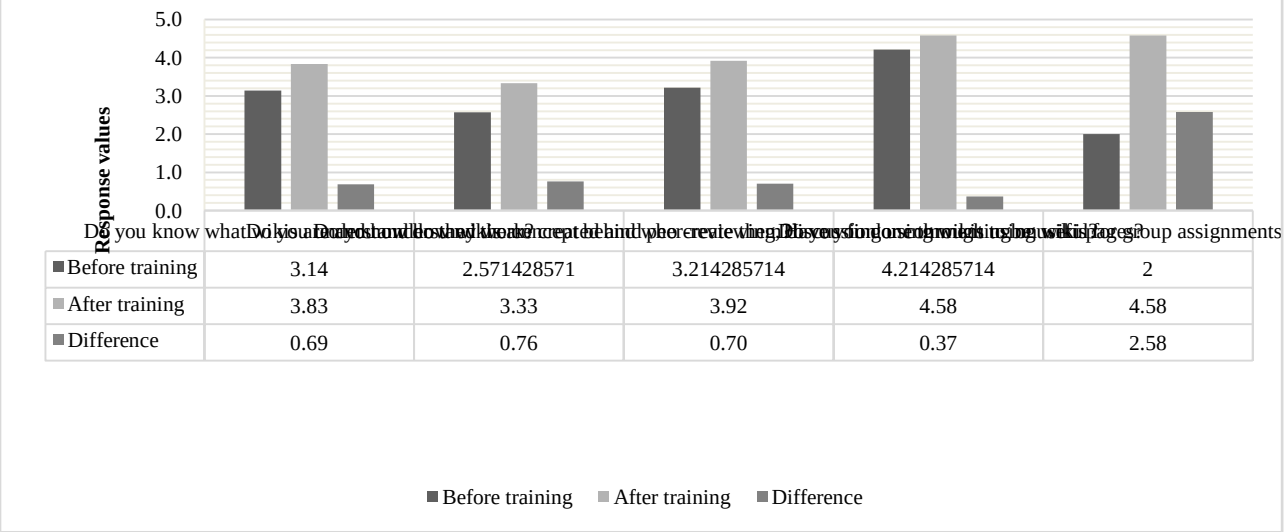
After 1 ½ weeks into the assignment, the students were given another feedback form in which they were asked again about their perception towards Wikis. Only 13 entries could be taken for second process check as 3 students were absent. The results were positive and showed increase interest from the students. In all questions, the students chose 'Agree'and "Strongly Agree" showing that their understanding has improved. In addition to this, students agreed that Wikis are indeed useful when doing collaborative work. Fig. 3 shows these results. Fig. 4 is a comparison between students' perception of Wikis before and after training which shows that the average of agreeing to the question did increase after training on Wikis.This value for each question in process check 1 and 2 is calculated by assigning 1, 2, 3, 4, 5 values to responses from "Strongly Disagree" to "Strongly Agree" and then taking the aggregate for that question.



	Do you know what wikis are and how do they work?	Do you understand how wikis are created and who create them?	Do you understand the concept behind peer-reviewing, discussion or commenting on wiki pages?	Do you find using wikis to be useful?	Have you gone through using wikis for group assignments for any course in the past?
Strongly Disagree	0	0	0	0	0
Disagree	1	4	0	0	0
Neutral	3	3	3	0	0
Agree	6	3	8	6	6
Strongly Agree	3	3	2	7	7
Average	3.83	3.33	3.92	4.58	4.58
Median	4	3	4	5	5
SD	0.90	1.19	0.64	0.52	0.52

Strongly Disagree Disagree Neutral Agree Strongly Agree Average Median SD

Fig. 3: Frequencies of students' response to questions relating to perception towards Wikis after training



	Do you know what wikis are and how do they work?	Do you understand how wikis are created and who create them?	Do you understand the concept behind peer-reviewing, discussion or commenting on wiki pages?	Do you find using wikis to be useful?	Have you gone through using wikis for group assignments
Before training	3.14	2.571428571	3.214285714	4.214285714	2
After training	3.83	3.33	3.92	4.58	4.58
Difference	0.69	0.76	0.70	0.37	2.58

Fig. 4: Comparison of Averages of students' perception of Wikis before and after exercise

Table 7 - Comparison between studentsperceptions of Wikis before and after training: Wilcoxon signed rank summary

		Mean (SD)		Z	Asymp. Sig. (2-tailed)
		Before Training	After Training		*p<.05
1	Do you know what wikis are and how do they work?	3.14 (0.89)	3.83 (0.90)	-2.105[b]	.035
2	Do you understand how wikis are created and who create them?	2.57 (1.08)	3.33 (1.19)	-1.741[b]	.082
3	Do you understand the concept behind peer-reviewing, discussion or commenting on wiki pages?	3.21 (0.98)	3.92 (.64)	-2.298[b]	.022
4	Do you find using wikis to be useful?	4.21 (0.81)	4.58 (.52)	-1.400[b]	.162
5	Have you gone through using wikis for group assignments for any course in the past?	2 (1.24)	4.58 (.52)	-3.430[b]	.001

b. Based on negative ranks.
Note: 1 indicates – totally Disagree, 5 indicates Totally Agree

Table 7 shows the comparisons between the perceptions of students before and after training using Wilcoxon signed rank tests. Our null hypothesis is that there is no change in the results even after training the students, the hypothesis will be rejected if p<=0.05. The results show significant changes in the 1st, 3rd and 5th questions. Though not significant enough, the results for "How Wikis are created and who create them" are close to the threshold as compared to "Do you find Wikis useful". On the other hand, when comparing the means students perceptions improved when compared to before. Moreover, the standard deviation of the responses received for "After training" are less varied showing that they are more conclusive compared to before training. It can be concluded that the training did helped the students in improving their perceptions of Wikis in how they work, and use of peer-review and commenting on Wiki pages. Thus, we can reject the null hypothesis for 1st, 3rd and 5th questions. Table 8 shows the ranks and the distribution of the positive ranks, negative ranks and ties from the questions. As shown the

frequency of positive ranks was higher in all of the questions asked showing a higher score achieved in after training results. One interesting observation is for question 5 in which there were no negative ranks and had a positive rank of 15.

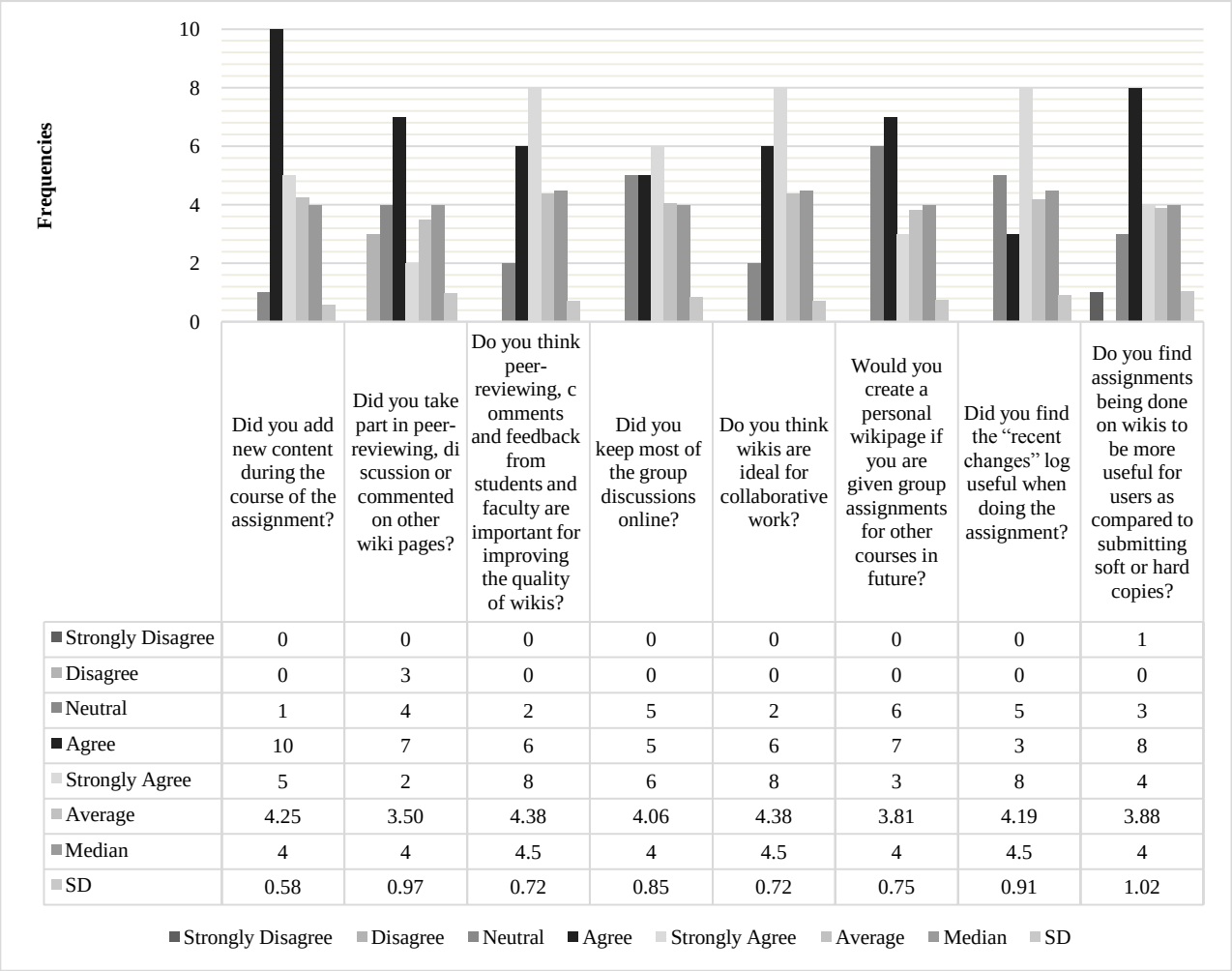
Table 8 - Comparison between students perceptions of Wikis before and after training: Wilcoxon signed rank order

			N	Mean Rank	Sum of Ranks
1	Do you know what wikis are and how do they work?	Negative Ranks	2[a]	4.75	9.50
	After - Before	Positive Ranks	9[b]	6.28	56.50
		Ties	5[c]		
		Total	16		
2	Do you understand how wikis are created and who	Negative Ranks	4[a]	4.25	17.00
	create them?	Positive Ranks	8[b]	7.63	61.00
	After - Before	Ties	4[c]		
		Total	16		
3	Do you understand the concept behind peer-reviewing,	Negative Ranks	4[a]	4.25	17.00
	discussion or commenting on wiki pages?	Positive Ranks	10[b]	8.80	88.00
	After - Before	Ties	2[c]		
		Total	16		
4	Do you find using wikis to be useful?	Negative Ranks	4[a]	6.50	26.00
	After - Before	Positive Ranks	9[b]	7.22	65.00
		Ties	3[c]		
		Total	16		
5	Have you gone through using wikis for group	Negative Ranks	0[a]	.00	.00
	assignments for any course in the past?	Positive Ranks	15[b]	8.00	120.00
	After - Before	Ties	1[c]		
		Total	16		

a. After < Before, b. After > Before, c. After = Before

4.3 Third Process Check

The first of the last two feedback forms (given at the end of the exercise)related to students' behaviour towards Wikis after going through the exercise. The second feedback asked the students about their response towardsWikis using defined roles and responsibilities for the conducting the exercise.Fig.5 and Fig. 6 shows the questions and the responses received.The students showed very positive attitude towards Wikiswith the addition of roles and responsibilities in the CSCL environment as shown in Fig.5. More than 90% of the students agreed that they added new and valuable content to the Wikis showing a sense of contribution attained by them. Students showed mixed responses when asked about their participation in discussion and peer reviewing. This is understandable as some of the students were going through Wikis for the first time and therefore some of them kept discussion face-to-face while others kept them online. This is also the reason why about 30% of the students were neutral when asked if they kept most of the discussion online. Other than a few number students who did notparticipate inonline discussions, more than 80% of the students agreed that peer reviewing and discussions are useful in improving the quality of Wikis. In addition to this, they agreed that the "recent changes" proved very useful and helped in doing collaboration workeasily by tracking the changes made by each user.Also majority of the students agreed that they found Wikis ideal for doing collaborative work as compared to traditional methods such as teacher-centre learning environments. They also agreed to use Wikis in the future, if faced with doing collaborative/group assignments in the future.



	Did you add new content during the course of the assignment?	Did you take part in peer-reviewing, di scussion or commented on other wiki pages?	Do you think peer-reviewing, c omments and feedback from students and faculty are important for improving the quality of wikis?	Did you keep most of the group discussions online?	Do you think wikis are ideal for collaborative work?	Would you create a personal wikipage if you are given group assignments for other courses in future?	Did you find the "recent changes" log useful when doing the assignment?	Do you find assignments being done on wikis to be more useful for users as compared to submitting soft or hard copies?
Strongly Disagree	0	0	0	0	0	0	0	1
Disagree	0	3	0	0	0	0	0	0
Neutral	1	4	2	5	2	6	5	3
Agree	10	7	6	5	6	7	3	8
Strongly Agree	5	2	8	6	8	3	8	4
Average	4.25	3.50	4.38	4.06	4.38	3.81	4.19	3.88
Median	4	4	4.5	4	4.5	4	4.5	4
SD	0.58	0.97	0.72	0.85	0.72	0.75	0.91	1.02

Fig. 5: Understanding students' behaviour towards Wikis after going through the exercise

Table 9 shows the results from one-sample Wilcoxon signed rank test for the responses to students' behaviour towards Wikis after conclusion of exercise.The one sample Wilcoxon was used as there was no data for comparison against a group that had gone through the exercise without the use of Wikis. Therefore, the results were compared against hypothesized means. The tests were ran against multiple hypothesized means in order to check the validity of the tests. The hypothesized mean should be closer to three (since responses range is from 1 to 5) which is why 2.5 and 3.5 were also selected besides 3. The tests show significant changes (where $p<.05$) in almost all the questions even when checking against multiple means. For question 1, 3, 4, 5, 7 the test shows significant difference for all three means. Thus, students' behavior improved dramatically for "adding new content", "finding peer-review and comments important", "participating in Wikis discussions" and "finding Wikis and its features ideal for collaborative work". The students behavior towards participation in peer-review was not significant. We believe this can be improved with more training and awareness. The remaining two questions relating to adoption of Wikis in future and submission of work compared to soft/hard copies showed significant changes for 2.5 and 3.0 but not for 3.5. It shows that the results were not so significant if the average mean is higher but the change is significantly higher if mean is closer to neutral (3) and disagree responses (1 or 2). Considering students who haven't worked with Wikis in the past will tend to give a lower value in response due to lack of experience in the area. Therefore, these two questions may also be accepted for rejecting the null hypothesis.

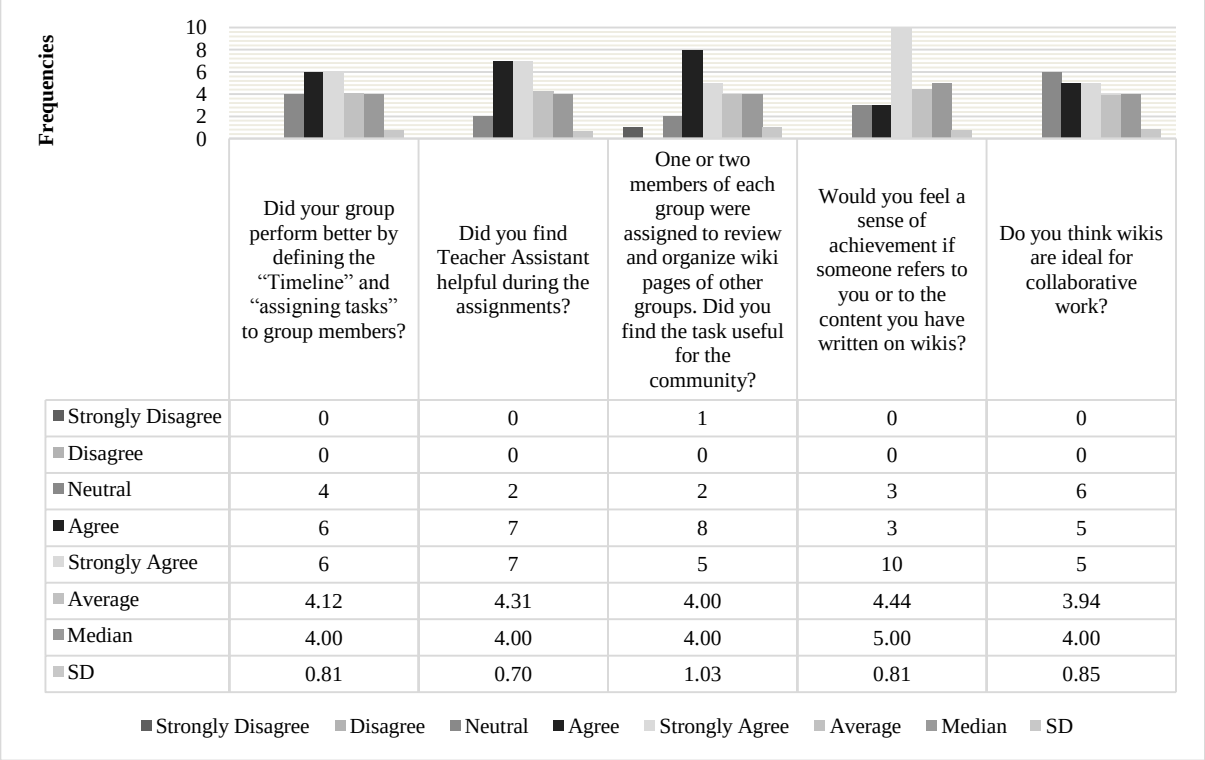
Table 9 - Comparison between students' behaviour towards Wikis after exercise against hypothesized values: One-sample Wilcoxon signed rank test

		Hypothesized value = 2.5		Hypothesized value = 3.0		Hypothesized mean = 3.5	
		Z	Asymp. Sig. (2-tailed) *p<.05	Z	Asymp. Sig. (2-tailed) *p<.05	Z	Asymp. Sig. (2-tailed) *p<.05
1	Did you add new content during the course of the assignment? – Hypothesized value	-3.630[b]	.000	-3.542[b]	.000	-3.343[b]	.001
2	Did you take part in peer-reviewing, discussion or commented on other wiki pages? - Hypothesized value	-2.952[b]	.003	1.890[b]	.059	-.108[b]	.914
3	Do you think peer-reviewing, comments and feedback from students and faculty are important for improving the quality of wikis? - Hypothesized value	-3.589[b]	.000	-3.397[b]	.001	-3.140[b]	.002
4	Did you keep most of the group discussions online? - Hypothesized value	-3.561[b]	.000	-3.017[b]	.003	-2.168[b]	.030
5	Do you think wikis are ideal for collaborative work? - Dummy	-3.589[b]	.000	-3.397[b]	.001	-3.140[b]	.002
6	Would you create a personal wikipage if you are given group assignments for other courses in future? - Hypothesized value	-3.573[b]	.000	-2.919[b]	.004	-1.436[b]	.151
7	Did you find the "recent changes" log useful when doing the assignment? - Hypothesized value	-3.581[b]	.000	-3.071[b]	.002	-2.422[b]	.015
8	Do you find assignments being done on wikis to be more useful for users as compared to submitting soft or hard copies? - Hypothesized value	-3.174[b]	.002	-2.491[b]	.013	-1.830[b]	.067

b. Based on negative ranks.

Note: 1 indicates – totally Disagree, 5 indicates Totally Agree

In the final feedback form, students gave their responses about the use of roles and responsibilities when working with Wikis. Fig. 6 shows these results. Other than a few exceptions, all the students found the new model to be helpful. More than 70% of the students agreed that defining timelines and distributing their work to group members helped in conducting the assignments successfully. Another positive finding was that the new "Teacher Assistant" role proved fruitful in the CSCL environment as 95% of the students welcomed the addition of the new role. Similarly, the students welcomed the idea of adding central users and peripheral users, who were required to suggest changes, organize content and review Wiki pages of other groups. In fact, 90% of the students agreed to the idea thus proving that it helped in improving the quality of the Wikis. Moreover, more than 75% of the students strongly agreed that they felt pride in creating and adding content on Wikis and that it will be useful to the community. In another question, we asked the students whether they feel Wikis was effective in doing collaborative work with the addition of roles and responsibilities.



	Did your group perform better by defining the "Timeline" and "assigning tasks" to group members?	Did you find Teacher Assistant helpful during the assignments?	One or two members of each group were assigned to review and organize wiki pages of other groups. Did you find the task useful for the community?	Would you feel a sense of achievement if someone refers to you or to the content you have written on wikis?	Do you think wikis are ideal for collaborative work?
Strongly Disagree	0	0	1	0	0
Disagree	0	0	0	0	0
Neutral	4	2	2	3	6
Agree	6	7	8	3	5
Strongly Agree	6	7	5	10	5
Average	4.12	4.31	4.00	4.44	3.94
Median	4.00	4.00	4.00	5.00	4.00
SD	0.81	0.70	1.03	0.81	0.85

Strongly Disagree Disagree Neutral Agree Strongly Agree Average Median SD

Fig. 6: Students response and behaviour towards use of Wikis using defined roles and responsibilities

Table 10 shows the comparison of students' response and behavoir towards the use of Wikis using defined roles and responsibilities against hypothesized values. This test is also done using One-sample Wilcoxon signed rank test. For this test as well 2.5, 3 and 3.5 hypothesized means were selected since they are closer to the absolute average of 1 to 5. The test reveal significant changes for responses given to all the questions acknowledging the addition of roles and responsibilities into the Wiki model. This includes "better management through timelines and assigning tasks to group members", "addition of teacher assistant role" and "members assigned to review Wikis of other groups". Also students showed a sense of achievement in the adoption of the model for all hypothesized values. Lastly, significant changes were seen when the students were asked if they find Wikis useful for collaborative work except for hypothesized mean equal to 3.5. Therefore, the null hypothesis can be rejected easily for the first four questions. There are still some doubts for the last question if it can be considered for rejecting the null hypothesis since it could not be proven when hypothesized mean was 3.5.

We also asked the students about the type of author/editor type in which they felt most comfortable. For diversity in answers, the question selection of allowed more than one type, as students may be comfortable with multiple author/editor types. The results showed us that the highest ratio of students opted for authors. This is a great achievement as one of the major goals in Wikis is to encourage users in becoming authors and adding new and valuable content. The second highest ratio went to technical editors, which is also very motivating for us. The remaining percentages distributed among social networkers, substantive experts. Another observation was that no student opted for counter-vandalism type. This might be because the students participated in a close group, as opposed to an open group where anyone can access the Wikis. Fig. 7.shows the ratios of student's preferences towards author/editor types.

Table 10 - Comparison between Students response and behaviour towards use of Wikis using defined roles and responsibilities against hypothesized values: One-sample Wilcoxon signed rank test

		Hypothesized value = 2.5		Hypothesized value = 3.0		Hypothesized mean = 3.5	
		Z	Asymp. Sig. (2-tailed) *p<.05	Z	Asymp. Sig. (2-tailed) *p<.05	Z	Asymp. Sig. (2-tailed) *p<.05
1	Did your group perform better by defining the "Timeline" and "assigning tasks" to group members? - Hypothesis Value	-3.564[b]	.000	-3.145[b]	.002	-2.462[b]	.014
2	Did you find Teacher Assistant helpful during the assignments? - Hypothesis Value	-3.585[b]	.000	-3.391[b]	.001	-3.091[b]	.002
3	One or two members of each group were assigned to review and organize wiki pages of other groups. Did you find the task useful for the community? - Hypothesis Value	-3.231[b]	.001	-2.653[b]	.008	-2.189[b]	.029
4	Would you feel a sense of achievement if someone refers to you or to the content you have written on wikis?- Hypothesis Value	-3.622[b]	.000	-3.358[b]	.001	-3.078[b]	.002
5	Do you feel Wikis are useful for collaborative work? - Hypothesis Value	-3.561[b]	.000	-2.879[b]	.004	-1.725[b]	.084

b. Based on negative ranks.
Note: 1 indicates – totally Disagree, 5 indicates Totally Agree

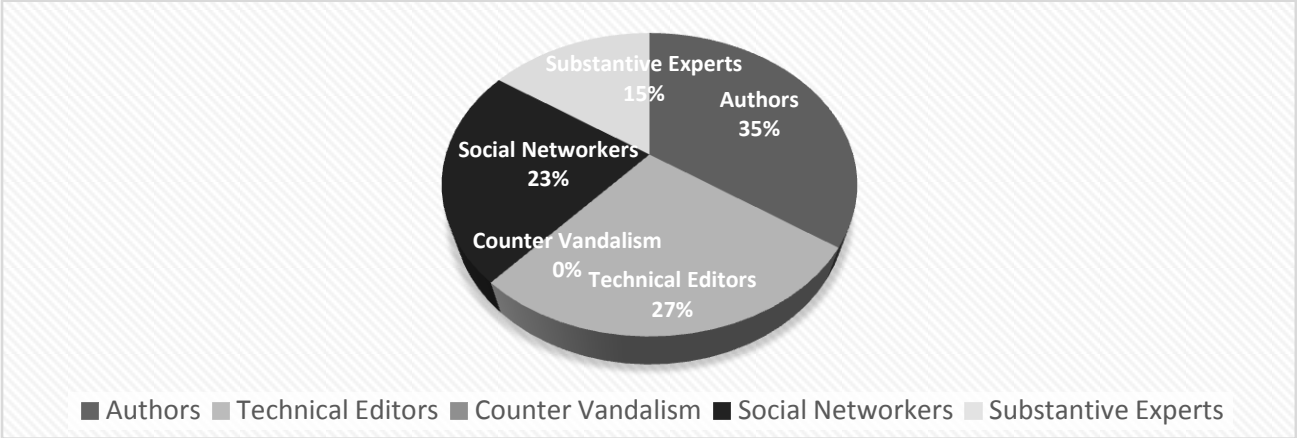


Fig. 7: Pie Chart showing preferences of author/editor types opted by the students

The results gathered show that students' perception and understanding of Wikisimproved after going through the exercise. Furthermore, studentsprefered working using defined roles when doing collaborative work. The students also acknowledged that the introduction of new roles and featureswas the reason for successful execution of the exercise.

5.0 DISCUSSION

The results gathered shows the success of the model in a CSCL environment, answers our research questions and identifies areas for improvement. As discussed before Wikis is one of the best platforms for conducting computer-supported collaborative work. However, basic Wikis do not provide all the features necessary for manage an efficient academic and research CSCL environment. With the addition of roles and responsibilities into an iterative model, the students and teachers were able to work effectively.One of the students commented when asked why he/she thought Wikis is useful in CSCL environment.

"I can communicate well with my group members regarding our assignments"

Another student commented

"We can discuss online without having to meet face-to-face"

"Because it make me and my group members discuss about the topic easily"

There were some disagreements as well like this one here.

"My communication skill will not expand since we just need to discuss through online."

This is useful as it identifies a requirement that students might want to initiate a group chat or call session for discussing something. Thus suggesting towards addition of this feature in Wikispaces for allowing students performing their roles effectively.

Another student commented

"It would be great if I was notified whenever someone edits my Wiki or a discussion is initiated".

Students do have to option to subscribe themselves to Wiki pages. Training session should highlight this feature or the system have this option enabled by default.

Our primary focus was to make Wiki a success with the help of defining roles and responsibilities. The results showed that students agreed that the model helped them in executing the exercise more smoothly. When asked about their views about addition of roles and responsibilities some of the commented the following:

"The addition of central and peripheral users is useful because we can know the other group's progress and we can learn from their topics as well as improve them"

Thus it can be concluded that defining roles and responsibilities not only helped in executing the exercise better but also helped in identifying missing features that should be added to make users perform their role properly.

6.0 FUTURE WORK

The model will prove useful for researchers who wish to implement or develop a CSCL system using users and roles. A system based on this model can monitor progress of users participating in the exercise, based on their roles and responsibilities. This approach is applicable on other domains as well. For instance, a software development company which wishes to use Wikis will have to modify the model according to their users and roles. This will also require changing the parameters of the process checks.

Social networking systems can also play a key factor in active participation and knowledge transfer. We wish to explore this by incorporating it into the system and checking whether it increases the active participation further or not.

7.0 CONCLUSION

Our research focused on improving the Wikis used in CSCL environment. We hypothesized that a model with defined users and roles for the CSCL environment will help in improving the Wikis. Our research identified new users and roles (mentioned in Table 3) into the university's CSCL environment and their introduction proved very helpful.

Our results shows that introduction of these roles and responsibilities into an iterative mode, allowed students to work effectively as a group and helped instructors and teaching assistant in assessment. In addition to this, applying process checks at different stages of the exercise cycle ensuresmonitoring of the model and its execution. The hypothesis was proved by conducting the Wilcoxon signed rank test showing significant differences in majority of the questions asked during the exercise relating to student's perceptions and behavoir towards Wikis and defined roles and responsibilities. These roles and responsibilities will help researchers in suggesting CSCL system models for other domains and making sure all the necessary features are included that would allow roles to perform their responsibilities successfully.

8.0 ACKNOWLEDGMENT

The preparation of this manuscript has been supported by University of Malaya Flagship Grant (FL001-2012) and University of Malaya Research Grant UMRG (RG093/12ICT).

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