MEDIAWIKI AND GOOGLE DOCS AS ONLINE COLLABORATION TOOLS FOR GROUP PROJECT CO-CONSTRUCTION

SAMUEL KAI-WAI CHU

Division of Information and Technology Studies, Faculty of Education
The University of Hong Kong, Pok Fu Lam Road, Hong Kong
Email: samchu@hku.hk

DAVID KENNEDY[1] and MAGGIE YEUK KI MAK[2]
Teaching and Learning Centre, Lingnan University, Castle Peak Road, Hong Kong[1]
CITE, Faculty of Education, The University of Hong Kong[2]
Email: davidmkennedy@LN.edu.hk[1] and davidmkennedy@LN.edu.hk[2]

This paper reports and describes the use of MediaWiki and Google Docs as online collaboration tools for co-constructing knowledge in a group project. Undergraduate Information Management students used MeidaWiki and Google Docs as collaboration tools for carrying out two separate projects. We assessed and compared students' perception on the effectiveness of MediaWiki and Google Docs after the completion of the projects. Results indicated positive experiences from using the tools for online collaboration in the group projects for some of the students. More students found MediaWiki an effective knowledge management tool than Google Docs.

1. Introduction

It is essential to master the ability to collaborate with other people (Elgort 2008). During the process of collaboration, information is integrated, knowledge is acquired, and new ideas may sparkle. Many key innovations are the results of collaborative work. Mastering collaboration skills prepares students for contribution in the workforce and society. An effective instrument certainly can enhance the process of collaboration. Social-networking Web 2.0 technologies such as Twitter, Facebook, MySpace, and blogs are applications for exchanging thoughts and communicating via the Web with no time and place restrictions.

Wikis, another Web 2.0 technology, have also been shown to be powerful web-based platforms for communication, collaborative authoring, and information sharing (Parker, 2007; Ravenscroft, 2009; Trentin, 2009). The family of Wiki applications (e.g., Wikidot, Mediawiki, PBWiki) has received tremendous attention and popularity since the launch of Wikipedia in 2002. Similar to other Web 2.0 technologies, Wikis, which combine the functionality of a word processor and a web browser, are characterized by simplicity,

accessibility, and interoperability[a]. As long as a computer with internet access is available, web users are able to create and edit the content of Wiki pages collaboratively without the technical knowledge required for writing HTML code. Google Docs, which is also a Web 2.0 technology, is a free web-based application that allows users to create and to share online documents, spreadsheets, presentations, and forms. It was first released on October 10, 2006 with web-based word processor and spreadsheet features. The presentation feature has been added since September 17, 2007 (Wikipedia, 2009). Similar to Wikis, Google Docs allows concurrent online editing and collaboration for knowledge building by multiple users with minimal technical knowledge of HTML.

In recent years, education has been undergoing a shift from teacher-centered instruction-based to student-centered inquiry-based learning. (Chu et al., 2008) Students are frequently required to engage in collaborative learning activities such as group projects, presentations, group discussion, and peer evaluation that require significant collaboration and communication with classmates. In the current study, we assessed and compared the perceived effectiveness of two specific online collaboration tools, Google Docs and MediaWiki, from the perspectives of undergraduate students in the Information Management program at the University of Hong Kong.

2. Literature Review

2.1 *Collaborative learning and knowledge management*

In recent years, collaborative learning, which has been shown to benefit students in terms of enhanced knowledge acquisition and better interpersonal skills development, has become an important form of classroom teaching (Coyle, 2007; Oxford, 1997). Collaborative learning involves joint intellectual efforts by students and teachers, and in most instances, involves students working in groups (Smith & MacGregor, 1992). More specifically, it often involves social interactions as small groups of students solve an academic problem together (Alavi, 1994). As a learning approach, it emphasizes social and intellectual interaction in the learning process such that the differences in knowledge, skills, and attitudes among collaborators become strengths rather than weaknesses (Hartley, 1999). Knowledge is shared and acquired during communication, negotiation, and production of materials (Gros, 2001; Smith & MacGregor, 1992). Through collaborative learning, learners are equipped with stronger analytical skills in interpreting information and constructing further knowledge (Lowyck & Poysa, 2001). In return, they contribute to knowledge construction and sharing in their learning community (Scardamalia & Bereiter, 2006).

Knowledge construction and sharing are among the processes involved in knowledge management (Dalkir, 2005). Recent research illustrates that effective knowledge management is able to enhance teaching and learning in a higher education setting

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[a] "The ability of systems to exchange and make use of information in a straightforward and useful way; this is enhanced by the use of standards in communication and data format." (A Dictionary of Computing, 2008).

(McCarthy, 2006). Scardamalia and Bereiter (2006) argued that the main purpose of acquiring knowledge was to induce further knowledge creation. The SECI model for knowledge creation of Nonaka and Takeuchi (1995) laid the foundation for a considerable amount of research on knowledge management in education. SECI stands for a four-stage conversion process: socialization, externalization, combination, and internalization. Nonaka and Takeuchi (1995) argued that knowledge creation is a spiraling process of interactions between explicit and tacit knowledge in this four-stage process. While collaborative learning has been seen to result in co-construction of shared knowledge (Jeong & Chi, 1997), knowledge co-construction is a series of collaborative activities that lead to the development of a shared understanding of concepts (Lipponen, 2002). Knowledge sharing links up individual knowledge users such that knowledge resides and attains its value within the community (Hendriks, 1999). Factors such as student interactions and the communication tool often affect the effectiveness of knowledge construction and sharing (Veerman & Veldhuis-Diermanse, 2001).

2.2 A *Wiki as a collaborative tool*

The development of Web 2.0 technologies has harnessed cyberspace in a more interactive and collaborative manner which has increased individuals' social interactions and active engagement (Murugesan, 2007). Among Web 2.0 technologies, Wikis are considered the poster child example (Rollett et al., 2007) and have been described as an ideal online platform for collaborative projects (Engstrom & Jewett, 2005). The web-based open-editing functions of Wikis allow a relatively low-cost knowledge creation process (Stvilia, Twidale, Smith, & Gasser, 2008). Since users are able to create and revise materials and documents easily, Wikis have served as convenient co-authoring tools to stimulate publication (Lamb & Johnson, 2007). The most well known example is the Wikipedia, which is perhaps the most influential wiki-based web project. Wikipedia is now one of the most commonly used encyclopedias in the world (Richardson, 2009). Thousands of web users have volunteered their time in co-authoring this high-quality encyclopedia in their native language (Tapscott & Williams, 2006). However, unlike any other encyclopedia, Wikipedia is not annually reviewed by appointed reviewers but reviewed when seen fit by peers (Long, 2006).

The characteristics of a wiki as a shared tool fit well with the processes associated with collaborative learning and knowledge management. In the education domain, web-based environments can provide platforms for joint problem-solving, knowledge building and sharing (Nevgi et al., 2006) where learners are able to practice, collaborate, reflect critically, negotiate, and build consensus similar to a face-to-face setting (Liaw et al., 2008). Educators have seen considerable benefits of using collaborative web-based tools to promote learning within a constructivist framework (Richardson, 1998). Applications of Wikis in education include individual and group projects, course management and distance education (Bold, 2006; Parker & Chao, 2007). Previous research has focused on four major areas: the rationale for using wikis, collaborative learning and writing, knowledge building and management, and sharing and structuring of information (Bold,

2006; Bruns & Humphreys, 2007; Changwatchai, 2005; Chu, 2009; Chu, 2008; Coyle, 2007; De Pedro et al., 2006; Engstrom & Jewett, 2005; Fountain, 2007; Jones, 2008; Long, 2006; Nicol et al., 2005). The research literature provides evidence that wikis provide useful platforms for collaborative learning activities at different education levels and in different subject areas (Lamb & Johnson, 2007). A number of studies have also reported heightened accessibility and effective collaboration between tertiary students through the use of wikis (Bold, 2006; Chu, 2008; Coyle, 2007; Nicol et al., 2005). In particular, Augar, Raitman, and Zhou (2004) have successfully enhanced social interaction with an icebreaker assignment using MediaWiki. In another example, Bruns and Humphreys (2005) adopted MediaWiki for developing an encyclopedia in an undergraduate new media technologies course.

There have also been discussions on the potential pitfalls associated with the use of wikis in education. Rollett et al. (2007) noted the uncertainties in providing stable services of Web 2.0 technologies by the start-up companies. In addition, some applications and functions of a wiki may be disabled when it is installed on private servers owned by schools or universities. In order to maximize the benefits of using wikis in education, the existing teaching practices and learning beliefs may need to be revised (Thompson, 2007). For example, the traditional framework on attending scheduled classes may need to be changed to a mode that operates around-the-clock. Thus, there appear to be both positive and negative aspects in the use of wikis in educational settings. Effective implementation would seem to rely on understanding the balance between the pros and cons.

2.3 *Research gap*

A considerable amount of recent research has discussed the grounds for Wikis as collaborative learning tools in education and some explicitly focused on the use of Wikis in completing group projects (Bold, 2006; Parker & Chao, 2007). However, the use of Google Docs in an academic setting remains largely unexplored in the literature even though the collaborative features of MediaWiki and Google Docs are relatively comparable. It is important for educators to acknowledge how these newly developed collaborative tools facilitate students' learning and to determine their suitability for educational uses. In hopes to enrich the empirical findings in this domain, we evaluated the perceived effectiveness of MediaWiki or Google Docs as online collaboration tools for project co-construction by undergraduate information management students.

3. Research Method

The main research objectives of this study are:
  (i) to evaluate if MediaWiki was perceived as an effective online collaboration tool;
  (ii) to evaluate if Google Docs was perceived as an effective online collaboration tool ;
 (iii) to compare the perceived effectiveness of MediaWiki and Google Docs;

(iv) to examine whether enjoyment in using MediaWiki related to students' perception on whether it was an effective collaboration tool; and

(v) to examine whether enjoyment in using Google Docs related to students' perception on whether it was an effective collaboration tool.

Twenty-two undergraduate students in the Information Management program at the Faculty of Education (The University of Hong Kong) were invited to participate in the study. All of them had used (1) MediaWiki in the project of the Knowledge Management course and (2) Google Docs for their final year project. In the project for the Knowledge Management course, students worked in groups of five to six people to produce a report on near miss analysis for traffic accident prevention using MediaWiki. The report contained 3,000 to 4,000 words with appendices (limited to less than 1,000 words). The content structure of the report and Wiki templates were provided by the course instructor (the first author). In the final year project, students worked in groups of two to three people or individually. Although templates were not given, the content structure and the evaluation criteria were clearly provided to the students via a word document. Collaboration was strongly encouraged in these projects, including a requirement for a personal journal discussing key issues. Based on these project experiences, students also filled in an online questionnaire about MediaWiki and Google Docs on a voluntary basis.

All students agreed to participate and written consents were obtained. They were asked to complete the survey after they had submitted their final year projects in May 2009. The students were assumed to have sufficient exposure to MediaWiki and Google Docs prior to the completion of the survey. The questionnaire was designed to evaluate the effectiveness of the use of Google Docs and MediaWiki. The questionnaire was uploaded on the survey software "Survey Monkey" where students were given clear instructions on completing the survey online. The survey questions included questions with 5-point Likert scales and open-ended questions. A comment box was available after each closed-ended question for students to provide additional information if necessary. A few open-end questions were also included to ask students for their overall comments about the two tools, and for addressing issues that have not been mentioned on the survey. Questions regarding MediaWiki and Google Docs were closely resembled. Twenty-one responses were received. Responses from six students were excluded because these students worked individually in the final year project. One response was received from a student who did not belong to this cohort was also excluded. Therefore, the final sample consisted of fourteen (n=14) students.

Quantitative data from questions with a 5-point Likert scale were analyzed using PASW Statistics 17 (as known as SPSS for its earlier versions). Non-parametric methods were used in the quantitative analysis for two reasons. First, due to the small sample size, it was difficult to interpret the shape of the histograms so that we did not assume any distribution of the underlying population. Second, when the sample size is small, formal tests of normality (such as Kolmovgorov-Smirnov test) have little power to discriminate between Gaussian and non-Gaussian distribution. Details from the responds to the open-ended questions are also discussed.

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4. Findings and Discussion

Students' rating on MediaWiki and Google Docs in terms of usage experience, severity of potential problems, and knowledge management were analyzed. For each of these aspects, we evaluated the tools separately by examining the descriptive statistics. Then we compared of the tools with Wilcoxon signed ranks tests. Lastly, we examined the correlations between enjoyment in using the tools with other usage experiences and potential problems.

4.1 *Usage Experience*

Students' usage experience of MediaWiki seemed to be positive. Table 1 reports the descriptive statistics of ratings related to students' usage experience of MediaWiki in their group projects. Ease-of-use received the highest rating from the students. Most importantly, both the mean and median ratings on whether MediaWiki was a suitable tool for students to co-construct group projects online were higher than midpoint of the scale. More students found MediaWiki (1) easy to use and (2) a suitable tool for them to co-construct group projects online than those who did not. Except for quality improvement and user-friendly layout, the means of all other ratings (collaboration improvement, ease, and enjoyment) were greater than the midpoint of the scale. Furthermore, the median on collaboration improvement, ease, and suitability exceeded the midpoint of the scale.

Table 1. Descriptive Statistics: ratings related to students' usage experiences of MediaWiki in group projects

| | Mean (SD) | Median | Frequency | | | | |
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Improves the collaboration among group members	3.50 (.76)	3.50	0	1	6	6	1
Helps improve the quality of your group report	2.79 (.89)	3.00	1	4	6	3	0
Easy to use	3.50 (.94)	4.00	1	0	5	7	1
Enjoy working on group project using MediaWiki	3.21 (.89)	3.00	1	0	9	3	1
User-friendly layout	2.64 (1.15)	2.00	2	6	1	5	0
A suitable tool for students to co-construct group projects online	3.43 (.852)	4.00	1	0	5	8	0

The results related to students' Google Docs experiences seemed to be less clear. Table 2 provides the descriptive statistics on the ratings related to students' usage experience of Google Docs in their group projects. In general, students found Google Docs easy to use with a user-friendly layout. Similar to MediaWiki, ease-of-use also received the highest ratings from the students. However, the mean and median ratings on collaboration improvement, quality improvement, enjoyment, and suitability were equal to or lower than the midpoint of the scale. Unlike MediaWiki, the mean and median ratings on user-friendly layout exceeded the midpoint of the scale.

Table 3 provides the comparisons between the ratings on Google Docs and MediaWiki for items related to usage experience using Wilcoxon signed rank tests. Results show no significant differences between Google Docs and MediaWiki. However, MediaWiki seemed to receive higher ratings when the raw means were compared. It was

Table 2. Descriptive Statistics: ratings related to students' usage experiences of Google Docs in group projects

	Mean (SD)	Median	Frequency				
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Improves the collaboration among group members	2.79 (1.31)	2.50	2	5	3	2	2
Helps improve the quality of group report	2.43 (1.02)	2.50	3	4	5	2	0
Easy to use	3.57 (1.28)	4.00	1	2	3	4	4
Enjoy working on group project using Google Docs	2.71 (1.27)	3.00	3	3	4	3	1
User-friendly layout	3.29 (1.39)	3.50	2	2	3	4	3
A suitable tool for students to co-construct group projects online	2.86 (1.23)	3.00	2	4	3	4	1

worth noting that, although it had much lower mean and median ratings on suitability, Google Docs received a much higher rating on user-friendly layout. A possible explanation would be the comparable features of Google Docs to other commonly used word processors.

Table 3. Comparison on students' usage experiences in using Google Docs and MediaWiki: Wilcoxon signed ranks tests

	Mean (SD)		Z	Asymp. Sig (2-tailed)
	MediaWiki	Google Docs		
Improves the collaboration among group members	3.50 (.76)	2.79 (1.31)	-1.93	.054
Helps improve the quality of your group report	2.79 (.89)	2.43 (1.02)	-1.18	.236
Easy to use	3.50 (.94)	3.57 (1.28)	-.262	.794
Enjoy working on group project using the tool	3.21 (.89)	2.71 (1.27)	-1.64	.100
User-friendly layout	2.64 (1.15)	3.29 (1.39)	-1.59	.111
A suitable tool for students to co-construct group projects online	3.43 (.852)	2.86 (1.23)	-1.87	.062

4.2 *Potential Problems*

Table 4 provides a measure of the perceived severity of potential problems faced by the students when they used MediaWiki in their projects. Slightly more students rated the severity of the identified potential problems on the left side of the scales and half of the students did not report other potential problems. Except for privacy issues in posting

items, the mean and median values of other items (creating new pages, uploading files, comfort levels in editing group members' work, and others) were either equal to or lower than the midpoint of the scale. Therefore, the problem identified did not perceive as severe to students. Neither did students seem to feel very uncomfortable in editing group members' work. They did not find many problems in creating new pages and uploading files, although one student explicitly reported on having problems in text editing due to the limited functionality of MediaWiki.

Table 4. Descriptive Statistics: the severity level of the potential problems on using MediaWiki

	Mean (SD)	Median	Frequency				
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Creating new pages	2.64 (1.22)	3.00	3	3	5	2	1
Uploading files	2.29 (1.20)	2.00	5	3	3	3	0
Uncomfortable in editing group members' work	2.79 (1.12)	3.00	2	3	6	2	1
Privacy issues in posting items	3.14 (1.46)	3.00	3	1	4	3	3
Others	2.07 (1.33)	1.50	7	2	3	1	1

In Table 5 the perceived level of severity of the potential problems is shown. All means and medians were either equal to or below the midpoint of the scale. However, some students reported editing or formatting problems when using Google Docs. One student indicated that the format of his document changed automatically without notification. Another student found some errors in the format of the document when he opened the document in MS applications. Another reported errors when more than one user edited the page at the same time.

Table 5. Descriptive Statistics: the severity level of the potential problems on using Google Docs

	Mean (SD)	Median	Frequency				
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Creating new pages	2.93 (1.33)	3.00	2	4	3	3	2
Uploading files	2.79 (1.31)	2.00	2	6	0	5	1
Sharing files	2.79 (1.19)	3.00	2	4	4	3	1
Uncomfortable in editing group members' work	3.00 (1.24)	3.00	2	2	6	2	2
Privacy issues in posting items	2.29 (.91)	2.00	3	5	5	1	0
Others	2.14 (1.29)	2.00	6	3	3	1	1

Table 6 provides comparisons between the ratings on Google Docs and MediaWiki for items related to the level of severity of potential problems using Wilcoxon signed rank tests. The ratings on problems regarding privacy issues in posting items were significantly different, such that the severity level was higher for MediaWiki than Google Docs. This result was reasonable because the content in the MediaWiki page could be searched by

any internet user. The mean rating of potential problems in creating items, uploading files, and feeling uncomfortable in editing group members' work of Google Docs were higher than MediaWiki, although the differences were not statistically significant.

Table 6. Comparison on the severity level of potential problems in using Google Docs and MediaWiki: Wilcoxon signed ranks tests

	Mean (SD)		Z	Asymp. Sig (2-tailed)
	MediaWiki	Google Docs		
Creating items	2.64 (1.22)	2.93 (1.33)	-.79	.43
Uploading files	2.29 (1.20)	2.79 (1.31)	-1.47	.14
Feeling uncomfortable in editing group members' work	2.79 (1.12)	3.00 (1.24)	-.72	.74
Privacy issues in posting items	3.14 (1.46)	2.29 (.91)	-2.14	.03*
Others	2.07 (1.33)	2.14 (1.29)	-.58	.56

*$p < .05$

4.3 *Knowledge Management*

Table 7 shows the descriptive statistics of students' evaluation of MediaWiki as an effective knowledge management technology in terms of knowledge creation, knowledge capturing, and knowledge sharing. All three ratings showed strong positive tendency – most students gave scores of "3" or "4". Three students explicitly indicated that MediaWiki was an effective tool in knowledge sharing. The negative rating (1 – Not at all) on each of the three items in this section were given by the same student. Except this one student, all other students seemed to find MediaWiki an effective knowledge management tool.

Table 7. Descriptive statistics: MediaWiki as a knowledge management tool

	Mean (SD)	Median	Frequency				
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Knowledge creation	3.29 (.83)	3.00	1	0	7	6	0
Knowledge capturing	3.07 (.73)	3.00	1	0	10	3	0
Knowledge sharing	3.36 (.93)	3.00	1	0	7	5	1

The results for Google Docs seemed to be less apparent than the results for MediaWiki. Table 8 reports the descriptive statistics of students' evaluation on Google

Table 8. Descriptive statistics: Google Docs as a knowledge management tool

	Mean (SD)	Median	Frequency				
			Not at all (1)	(2)	(3)	(4)	Very much so (5)
Knowledge creation	2.93 (1.33)	3.00	2	4	3	3	2
Knowledge capturing	3.07 (1.07)	3.00	1	3	5	4	1

Knowledge sharing	3.14 (1.23)	3.00	1	4	3	4	2

Docs as an effective knowledge management tool in terms of knowledge creation, knowledge capturing, and knowledge sharing. The ratings on these three items were more widely spread across the scale than the ratings on the same items of MediaWiki. All median values were equal to the midpoint of the scale. However, the mean ratings on knowledge capturing and knowledge were all on the positive side. To a lesser extent, students also seemed to find Google Docs an effective knowledge management tool.

Table 9 shows the comparison of the ratings of knowledge management for MediaWiki and Google Docs. MediaWiki received higher ratings as an effective tool in enabling knowledge creation and knowledge sharing than Google Docs, although such differences were not statistically significant.

Table 9. Comparison on knowledge management of Google Docs and MediaWiki: Wilcoxon signed ranks tests

	Mean (SD)		Z	Asymp. Sig (2-tailed)
	MediaWiki	Google Docs		
Knowledge creation	3.29 (.83)	2.93 (1.33)	-1.22	.22
Knowledge capturing	3.07 (.73)	3.07 (1.07)	.00	1.00
Knowledge sharing	3.36 (.93)	3.14 (1.23)	-.79	.43

4.4 *Correlation with Enjoyment*

Non parametric correlations were computed to explore the possible relationships between enjoyment and other usage experiences and potential problem items on the questionnaire. Results for MediaWiki (refer to table 10) showed that enjoyment was positively correlated to collaboration improvement, quality improvement, and suitability. In addition, feeling uncomfortable in editing group members' work was negatively correlated to enjoyment. More uncomfortable in editing group members' work, students less enjoyed working on the group project using MediaWiki.

Table 10. Correlation: enjoyment with other usage experiences and potential problems on MediaWiki

Usage experience:	Correlation
Improves the collaboration among group members	.737**
Helps improve the quality of group project	.742**
Easy to use	.071
User-friendly layout	.305
A suitable tool for students to co-construct group projects online	.648*
Potential problems:	
Creating new pages	.487
Uploading files	-.243
Uncomfortable in editing group members' work	-.710**
Privacy issues in posting items	-.489
Others	-.302

*$p < .05$; **$p < .01$.

For Google Docs, enjoyment was positively correlated to the rest of the usage experience items (collaboration improvement, quality improvement, ease, user-friendly layout, and suitability). There were no significant correlations between enjoyment and the severity levels of all identified potential problems. Results are shown in Table 11.

Table 11. Correlation: enjoyment with other usage experiences and potential problems on Google Docs

Usage experience:	Correlation
Improves the collaboration among group members	.853**
Helps improve the quality of group project	.784**
Easy to use	.890**
User-friendly layout	.544*
A suitable tool for students to co-construct group projects online	.958**
Potential problems:	
Creating new pages	.164
Uploading files	-.014
Sharing files	-.086
Uncomfortable in editing group members' work	-.303
Privacy issues in posting items	-.152
Others	-.493

*$p < .05$; **$p < .01$.

5. Conclusion and Implications

In this study, we surveyed students regarding their project experiences in using MediaWiki and Google Docs in terms of usage experience, perceived severity of potential problems, and knowledge management through an online questionnaire. We aimed to evaluate students' perception on whether MediaWiki and Google Docs can be effective online collaboration tools. In addition, we compared the perceived effectiveness of MediaWiki and Google Docs for knowledge management and collaboration. Finally, we explored the relationship between enjoyment in using the tools with other usage experiences and the severity of perceived potential problems. Results revealed that some students found MediaWiki and Google Docs easy to use with user friendly layouts. The potential problems identified in the study did not seem to be overwhelmingly problematic, although some students indicated privacy concerns and formatting/editing problems in using these tools. Overall, some students perceived MediaWiki and Google Docs as effective knowledge management tools. More students tended to find MediaWiki more effective for their group projects than Google Docs. Positive relationships were found between enjoyment in using MediaWiki and collaboration improvement, quality improvement, and suitability. In addition to collaboration improvement, quality improvement, and suitability, enjoyment in using Google Docs positively correlated with ease and user-friendly layout.

Although we observed differences in students' ratings on MediaWiki and Google Docs, only a few of these differences were shown to be statistically significant. A possible explanation for these results is most likely related to the small sample size. Future studies

should aim at surveying a larger group of users. In addition, participants gave little feedback on sharing their experiences and opinions in the open-ended questions on the survey. Lastly, the questions on the survey were opinion-based. Students may have interpreted the ratings on the Likert scale in different ways. In addition to the items identified in this study, future studies should aim to include some objective indicators.

Despite these limitations, the current study shed light on how some undergraduate students perceived the effectiveness of MediaWiki and Google Docs from their group project experiences. Although no definite conclusion on whether MediaWiki and Google Docs were effective tools for online collaboration could be drawn from the study, some of the ratings did reflect positive experiences from using the tools for online collaboration in the group projects for some students. Six of the fourteen students indicated that they might use MediaWiki for other purposes in the future. For Google Docs, seven students considered usage for other purposes in the future.

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