Experiences of Using Wiki as a Participatory Learning Tool in Teacher Education

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Abstract   Wikis have potential for facilitating learning in the online environment but studies have identified varying degrees of success. The implementation of a new learning management system at the university provided a context for course instructors to explore the potential of web2.0 tools to facilitate collaborative learning. This research sought to understand teacher education students' experiences of working collaboratively using a wiki as the participatory technological web2.0 tool. The research study involved pre-service education teachers enrolled as either on-campus or distance (flexible) students in a compulsory first year curriculum paper. A quantitative and qualitative methodology was used to determine learner perspectives on working within a collaborative learning space. Working collaboratively using a wiki as a participatory technological tool was new to most pre-service teachers. Results from this study indicated that their experiences towards collaborative learning remained positive despite a number of challenges. Whilst each group's experiences varied, we identified three contributing factors to pre-service teacher's use of wiki as a collaborative learning tool. The student experiences were discussed in relation to the three factors supporting the development of collaborative learning: positive relationships, the role of the course instructor, and the web2.0 technology.

Keywords: *pre-service teacher, collaboration, wikis, web2.0, teaching strategies*

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1. Introduction

The wiki is a 'participatory' technology that allows for shared knowledge generation where users are able to write, edit and manipulate content through a collection of linked web pages in a shared space. Wiki technology can be accessed through a simple web-browser, has built in editors to simplify the creation of the web page, allows edit tracking, version retrieval, threaded discussions, varying access and edit rights, use of other media (such as sounds and images) and protected pages [25].

Hazari, North & Moreland [22] explained this notion of collective intelligence as being reliant on a participatory community of learners where information is collated, shared, processed and published. Such collaborative practice is thought to support participant interactions, engagement and understanding of the subject content at a deeper level [33,37], whilst at the same time promoting dispositions and skills associated with collaborative learning [16,49]. The process of building individual representations of knowledge in a participatory learning community that places learning in the control of the student is seen as the foundations of constructivism. Such student-centred learning is, however, reliant on learners' engagement and social interactions with which the wiki is becoming an increasingly favoured collaborative tool to use [5].

1.1. Pedagogical Potential

A number of studies on the use of wikis, particularly with tertiary level education students, have shared the positive aspects of such a collaborative learning tool as part of their coursework or assessment. Such "participatory communities" of learning [22] have been described where engagement and interaction has led to increased participant confidence [4,17,22]; development of critical thinking skills [49]; improved feedback [45]; evidence of deeper processing of content [33,52] and supporting constructivist, collaborative learning [23,42,45].

Other studies have identified some of the on-going challenges of using wikis, specifically at undergraduate level. Students appear to have limited experience of learning styles that enable them to work collaboratively (for example [25,37,47,55]. In their study of web2.0 technologies, Bennett, Bishop, Dalgarno, Waycott & Kennedy [2] identified this tension between good pedagogy of tertiary practice that involves collaboration, constructivist learning practices, academic contribution and distributed authorship and working with a collaborative learning tool.

Similarly, Naismith, Lee & Pilkington [37] reported that limited student experience of working and learning in a constructivist manner led to differences in participant interactions and presence within their group. Vratulis & Dobson [48] described similar experiences in their study, with students identifying the difficulties associated with negotiating roles and managing the group dynamics within

the developing community influencing their effective participation in the wiki.

Other studies have shown that tertiary level students have a reluctance or "discomfort" to edit one another's contributions as part of the collaborative process of writing within a wiki which can lead to superficial interactions [2] and inconsistent participation [21,24,26,38,40,52]. It has also been suggested that students need to develop greater collaborative skills in order to be able to use web2.0 tools, such as a wiki, effectively [50,54]. Other challenges with using wikis were centred around the use of the technology itself and the impact that had on student motivation and engagement [2,8,10,37,38,55].

Learning is about people and occurs within a social context [7] and we advocate for the shift from *e*-learning to *we*-learning, as described by Chatti, Dahl, Jarke & Vossen [7] as the emphasis towards a culture of collaboration in the online environment is encouraged. Social constructivist learning theory [44] underpins this shift towards *we*-learning [7] and therefore the implementation of related pedagogical practices that support learning within, or as, a community needs to be considered.

This shift however is not without its challenges, as instructors grapple with the philosophical, pedagogical and technological considerations required in supporting a socially constructivist learning (in this case, virtual) environment. If individuals are required to construct knowledge through interactions with other members of their virtual communities these environments need to be designed to support this kind of learning [11,12,41,44]. As Hadjerrouit [20] states, "…wiki technology alone does not make collaboration automatically happen" (p.45) and it is important to thoughtfully plan for, and manage, sound pedagogy to engage students in collaborative, constructive practice [21,39]. This requires explicit teaching and use of pedagogical approaches, strategies and tools that enhance collaboration and co-operation [7,21,29,43].

A prevalence of social technological tools are being used by students in their everyday lives which leads to the assumption that students who are already using web2.0 technologies would be just as likely to use them in an academic environment [14]. Yet this may not be the case with the shift to using technological tools in an academic environment being a new and emerging experience for many [2,12,46,53].

2. Methodology

2.1. Design and Research Question

The implementation of a new Learning Management System (Moodle) at the University of Canterbury has previously led the authors to explore the use of using web 2.0 technologies to facilitate blended, collaborative learning [12]. As staff and students were relatively new to the University Moodle environment, 'Learn', we were interested in exploring student perceptions of working collaboratively. In this study we were particularly interested in exploring the student experiences of e-learning resources associated with Moodle – in particular the wiki tool - with a purpose of informing future course development. The following research questions were considered:

- How do first year pre-service teachers respond to the use of collaborative learning experiences in an asynchronous learning environment?
- What aspects influenced students' use of wiki as a collaborative learning tool?

This research was carried out during the first semester of a core course within the three year primary Bachelor of Teaching and Learning degree. This compulsory first year course entitled 'Science, Health and Physical Education Curriculum Studies 1' consisted of three modules of equal weighting, delivered over a 10 week period.

The cohort of pre-service teachers involved in this course comprised on-campus as well as those who chose to study by distance, referred to as the flexible learning option (FLO). The University's asynchronous Moodle environment, 'Learn', provided the platform for the online course material for all students. On enrolment in the course the pre-service teachers were organised by the course lecturers into 35 randomly selected groups in preparation for the collaborative learning tasks. The random selection included representation of both on-campus and FLO pre-service teachers in each group. Pre-service teachers remained in these groupings for all of the learning tasks.

2.2. Learning Tasks

The Science component of the module had been specifically developed to utilise the capabilities of the Moodle environment and provided the context for this research. The teaching material on Learn consisted of study guides, readings, e-books, videos and learning tasks.

In order to encourage the students to engage with one another and work collaboratively, a series of authentic learning tasks were designed as part of the science module of the course. The purpose of these tasks was to support and develop students' understanding of primary science pedagogy. The development of the collaborative learning tasks was based on reports of 'best practice' [6,22,23,27,30,34,35,43] and previous findings from the pilot study [12]. The learning tasks are described elsewhere [13]. These series of tasks were progressive; they built upon student familiarity with the technology, development of group culture and collaborative practices and also cognitive processing.

The learning tasks were underpinned with the revised Blooms Framework (Anderson & Krathwohl, 2002 cited in [12,28]). The earlier tasks were composed of activities associated with the application and synthesis levels of processing. Later tasks required students to analyze, evaluate and create new content. Each learning task had clear learning outcomes and associated success criteria that were explicitly linked to a marking rubric. Pre-service teachers were encouraged to self-assess and group assess both during and after each learning task [12,13].

2.3. Data Collection

2.3.1. Questionnaires

The online self-evaluation questionnaires, adapted from Elgort, Smith & Toland [16] and previously been trialled in a pilot study [12], consisted of:
1. The pre-questionnaire. This was completed during the first week of the course. It was used to collect

demographic data, student perceived confidence and competence in using a range of information technology and student perceptions and experiences of working within an online environment.

2. The post-questionnaire. Following the conclusion of the course, information about students' perceptions of the learning experience and their use of wiki as a collaborative learning tool was collected.

The quantitative part of the self-evaluation questionnaires consisted of a series of statements, 29 pre- and 31 post-, that students were asked to agree or disagree on using a 5-point Likert scale. Item analyses were conducted to determine the internal consistency of each construct and Cronbach's alpha ranged from 0.91 to 0.93 indicating internal consistency. A number of similar questions were used in both the pre and post questionnaires in order to gain a better understanding of how student views may have changed following their experience. Open-ended questions, 5 pre- and 11 post-, elicited a range of qualitative comments that provided insight into those aspects that influenced students' collaborative learning and wiki use within the science module.

2.3.2. Student Activity

Using 'Learn', the University Moodle environment, course lecturers were able to track individual student activity within the science module. Data was collected from activity logs, version tracking (for the wikis) and forum posts for each student.

2.4. Data Analysis

Quantitative data from the pre and post-surveys were analysed using SPSS 18 statistical analysis software. Summary measures (mean and standard deviation) and distributions for the pre and post groups, as well as the matched sub-sample (those students who responded to both the pre and post questionnaires and identified as the 'continuing sample'), were completed for each question. In all cases, the matched sub-sample appeared representative of the group. Comparisons between 'paired' pre and post student responses for the matched sub-sample were analysed using non-parametric Wilcoxon Signed Rank Test statistics.

The framework for analysis of the open-questions on both the pre and post questionnaire was based on 'grounded theory' [19] where theory is derived and emerges from data systematically gathered and analysed using an inductive approach [9]. We independently coded the data then, using the constant comparative method [9], derived themes. In order to illustrate their relevance, the themes were also quantitatively analysed by counting the number of times they were mentioned by participants.

2.5. Sample Representativeness

Although 270 students were enrolled in the first year course 'Science, Health and Physical Education Curriculum Studies 1', students self-selected to participate in the research. The pre-questionnaire yielded a response rate of 51% (n=138). This number represented 65% of the on-campus students enrolled and 32% enrolled in the flexible learning option (distance). The post-questionnaire provided a response rate of 43% (115 students),

representing 43% of the on-campus students and 42% of the enrolled in the flexible learning option (distance).

For this report, the analysis of the data was based on those students who completed both the pre and post surveys (referred to as the 'continuing sample', n=67). The age range of the continuing sample is shown in Table 1. Of this sample, 8% were male and 92% female. The majority of the students in this continuing sample (76%) were enrolled in on-campus study.

Table 1. Description of the age distribution of the continuing sample (n=67)

	Age					
	17-20	21-25	26-30	31-35	36-40	Over 40
Total (%)	46	15	9	10	6	14

Most students indicated that they were experienced and confident in using productivity tools such as 'Word' and 'Email', as well as the 'Internet' and 'Facebook' (Table 2). Students were less experienced and confident with specific web based social tools such as 'Flicker', 'Bebo' and 'Twitter' and few students had experience or confidence in using web 2.0 collaborative tools such as 'forum' or 'wiki'.

Table 2. Student experience and confidence of using various digital technologies (n=67)

	Experience		Confidence	
	Mean	Standard Deviation	Mean	Standard Deviation
Email	3.60	0.57	3.54	0.68
Word	3.45	0.76	3.33	0.77
Internet	3.66	0.62	3.48	0.78
Moodle	3.00	0.70	3.00	0.67
YouTube	2.52	0.86	2.85	0.91
Facebook	3.27	1.11	3.16	1.19
Twitter	1.09	0.29	1.27	0.62
Flicker	1.27	0.51	1.27	0.64
Bebo	1.61	0.83	1.87	1.08
Forum	1.96	0.64	1.72	0.76
Blog	1.79	0.59	1.69	0.63
Wiki	1.79	0.62	1.81	0.63

3. Results

3.1. Collaborative Learning

Initially, when pre-service teachers were asked to identify what they were looking forward to about working in an online collaborative environment, two thirds identified social aspects of collaborative learning. These aspects included 'learning from others' (44% of responses), 'meeting new people' (13%) and 'being part of a team' (6%). However, few pre-service teachers identified the 'technological experience' (13%) as being something they were looking forward to and less than 10% had negative feelings about the idea of working in an online collaborative environment.

Prior to working in the wiki, pre-service teacher believed that interacting within a wiki group could support their learning' ($\bar{x}$ =3.86; SD=0.75; n=67). They also

identified the importance of both the accessibility of group members ($\bar{x}$ =4.02; SD=0.69; n=67) and the need to make connections with their group ($\bar{x}$ =4.08; SD=0.62; n=67). They also perceived that the participation of group members would result in a better wiki task ($\bar{x}$ =4.32; SD=0.66; n=67).

Following completion of the course there was no significant shift (Figure 1) in the pre-service teachers' perceptions that working within the wiki or forum could be a valuable learning experience (Wilcoxon Signed Ranks Test z=-0.823, P<0.410, n=67). Pre-service teachers were still positive about using this type of collaborative learning (post $\bar{x}$ =3.49, SD=1.05; n=67).
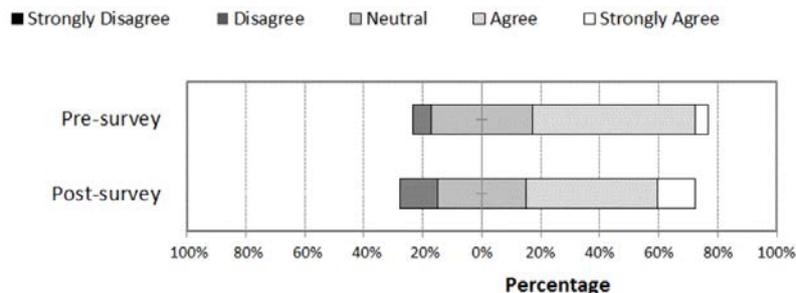

Figure 1. Responses to 'Working within a wiki or forum can be valuable learning experience.'

Following completion of the course, the mean scores for pre-service teachers indicated that they still agreed a wiki was a good collaborative tool where they were able to share thoughts and ideas (Figure 2). This was exemplified by one comment;

This is the first time I have used a Wiki so found it exciting as well as new to learn. I can certainly see the positive points in using a Wiki. [It is] an excellent way to gather other points of view on a subject. (#26)

Although the mean score for this item decreased from the pre ($\bar{x}$ =3.94; SD=0.57; n=67) to post ($\bar{x}$ =3.52; SD=1.02; n=67) survey (Figure 2) and the difference in pre-post scores for this item was significant (Wilcoxon Signed Ranks Test z=-3.09, P<0.002; n=67), the mean value for this item was still slightly positive.
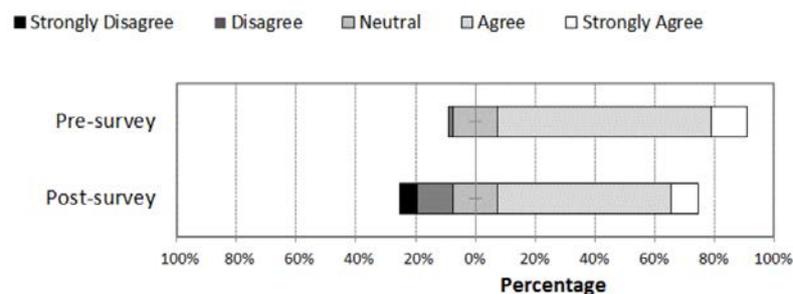

Figure 2. Responses to 'A wiki is a good tool for sharing ideas and thoughts'.

As one pre-service teacher commented;

I thought it was a really worthwhile experience. I found a lot out about human nature through the wiki, those whose took the time to contribute and those who sat back and 'let it happen'. It was very beneficial having other people to be able to chat with, bounce ideas around with. As a FLO [distance] student I think the wiki was fantastic, it took away the alone feeling. (#7)

And another;

Wikis to me have both positive and negative attributes. Positive in the way that it was a way of exploring your own ideas and others but the negative side is that not everyone is always on the same 'page'. As with any learning, not everyone will interpret the task or concepts taught the same. Some will be proficient learners whilst others may struggle. (#55)

3.2. Learning Experiences

On completion of the course, pre-service teachers still perceived working within the wiki as a valuable learning experience (Figure 1). When they were asked to identify the value they saw in this type of online learning, three key themes emerged from their responses; collaboration (39.3%), the use of contemporary technology (21.4%) and flexibility (13.4%).

3.2.1. Collaboration

As a key theme, collaboration was identified as a functional aspect that appeared to enhance task outcome. It also had a positive influence on pre-service teachers' perceptions of their learning experience. Pre-service teachers suggested that because the wiki platform provided a means of bringing different groups together it promoted stronger overall learning. This was because discussion was based on different viewpoints and perspectives. There was perceived value in being exposed to other people's ideas. The process of sharing was seen as important, pre-service teachers suggested wiki was a good tool for open discussion, where the sharing and extending of ideas had the potential of influencing learning.

I love online learning ... it helped me to interact and encouraged me to ask more questions about my work. I don't usually ask for help but online learning doesn't seem so personal for me so I ask any questions I need to and someone out there answers me!! (#87)

Additionally, when pre-service teachers were asked how their collaborative activities affected their learning in

the context of science, only 23% identified negative effects, the majority were positive (56%) or neutral (26%). The positive effects identified related to the social aspects of learning as well as improvement in their content knowledge. For example,

It was interesting comparing my learning experiences to others from around the country and having a supportive group made it easier to participate and helped in understanding certain things (social aspects #38)

It was good to see that my ideas were similar to the other ideas that were being thrown around in the task. I did miserably at science when I was at school, but the classes as well as these activities showed me that I am more than capable of learning more. Completing all the tasks helped me to gain a better understanding of the "World of Science." (content knowledge, #22)

The comments that related to negative effects on their learning related to difficulties associated with working in groups and the frustrations associated with completing the tasks with others for example,

To tell you the truth it ruined the course for me, I don't have a problem working in a team just not like that. (#89)

3.2.2. Contemporary Technology

The next largest theme identified from the responses of pre-service teachers to the survey question regarding the value they saw in online learning was the notion of using a contemporary web 2.0 tool. They identified wiki as tool that could not only enhance their own learning but one

that they would use as teachers in their own classrooms. For example,

We are learning about 21st century learning which is really important. We need to know these skills so there's no better way to put these skills into action (#108)

My 10-year-old uses wikis for her homework and because the children are so use to this way of collaborating they don't have dramas about who is doing what, in fact they are overjoyed when someone makes their work look good, or had a different thought about something. They realise they are able to learn even from each other and they don't feel less intelligent because of it. (#41)

3.3. Wiki Tool: Challenges to Learning

Prior to the start of the course, pre-service teachers identified with a perception that the online 'Learn' environment would facilitate groups of people working together (Figure 3; Pre $\bar{x}$ =3.48, SD=0.77; n=67). Following the course there was a significant shift between the pre-post participant views (Figure 3; Wilcoxon Signed Ranks Test z=-2.74, P<0.006, n=67) with more pre-service teachers moving to disagree or strongly disagreeing that an online environment is a good way to get groups working together. It appears that pre-service teachers identify that working with a wiki is a valuable learning experience and that the wiki is a good tool for sharing ideas, however the online environment is perceived a challenging when trying to organise and manage groups working together.
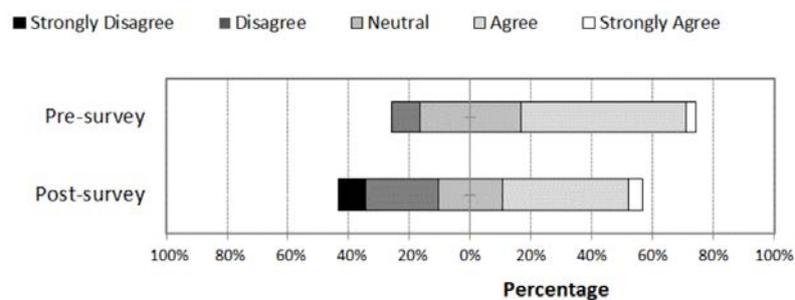
Figure 3. Responses to 'An online environment is a good way of getting groups of people working together'

The open-ended post survey questions revealed a number of main themes associated with aspects that made it challenging to complete the wiki tasks (Table 3), these are explored in more detail below. Participants' responses may fit in more than one theme.

3.3.1. Group Dynamics

Even though these pre-service teachers views of working in an online environment had shifted from an initial positive response, their final response was not negative and remained fairly neutral (Figure 3; Post $\bar{x}$ =3.09, SD=1.09; n=67). Similarly, when asked to respond to the statement 'Our group worked well together in an online environment', only 27% of pre-service teachers responses were negative (disagree or strongly disagree) (Figure 4; $\bar{x}$ =3.45, SD=0.77, n=67).

This suggests that although some of the pre-service teachers' experiences in working together may have been difficult at times, they were not defined by them as a

negative. This was exemplified by the following pre-service teacher comments

I thought it was a real worthwhile experience. I found a lot out about human nature through the wiki, those who took the time to contribute and those who sat back and 'let it happen'. (#7)

Wikis to me have both positive and negative attributes. Positive in the way that is was a way of exploring your own ideas and others' but the negative side is that not everyone is on the same 'page'. As with any learning, not everyone will interpret the task or concepts taught the same. Some will be proficient learners whilst others may struggle. (#56)

The social dynamics of the groups had the potential of limiting the effectiveness of wiki as a collaborative learning tool.

A summary of pre-service teacher perceptions of working within a wiki group are shown in Figure 4. When pre-service teachers were asked how satisfied they were with their groups effort in completing the wikis' their

response was slightly positive (Figure 4; $\bar{x}$ =3.16; SD=1.08; n=67). Although they indicated that their groups worked well (Figure 4; $\bar{x}$ =3.28; SD=0.97; n=67), a larger proportion felt that the workload was not spread evenly with 65% disagreeing or strongly disagreeing with the statement 'All members of our group did a fair share of the work' (Figure 4; $\bar{x}$ =2.32, SD=1.13, n=67) and they felt that some group members were less interested in participating in the wiki (Figure 4; $\bar{x}$ =2.87, SD=1.04, n=67). Overall pre-service teachers reported that using the wiki did not encourage better participation ($\bar{x}$ =2.45, SD=1.02, n=67).

Table 3. Survey themes identified from pre-service teachers responses to working with wikis. The selection of quotes shown provides examples of the subtheme definitions. The frequency and number of responses for each theme are provided (n=595 total)

| Theme: Group Dynamics 34% (n=221) |
| --- |
| *Subtheme: Group Roles* |
| It was easier when one women took the position of leader and delegated specific roles to each member of the group |
| I would suggest that this works best in small groups so that everyone participates and doesn't just leave others to do this. Randomly selected by (lecturer, programme) positions eg (leader, editor, researcher) would be good so that 'control freaks' don't just do all the work and laid back people do nothing |
| I also spent a lot more time contributing than I had expected because I had to contribute for others who weren't as well |
| *Subtheme: Participation* |
| I put my hand up as editor for some of the tasks and had to tackle with that whole process. I also didn't want to let any of my group down so I tried my best to stay on top of my tasks |
| Overall great tasks but difficult when others don't participate |
| I got frustrated that others did not participate much |
| *Subtheme: Contributions* |
| I also spent a lot more time contributing than I had expected because I had to contribute for others who weren't as well |
| I wanted to ensure I contributed as much as I could for the team. At first it was for the marks but soon it was for the team |
| Getting everyone to contribute as it was the same time as the ChCh Earthquakes and this made it difficult for some students |
| Theme: Communication 14% (n=90) |
| *Subtheme: Connectivity* |
| Having connection with other people made you feel like you want to go online and see what they had added to the wiki, or talked or asked about in the forum |
| It was very beneficial to have other people to be able to chat with, bounce ideas around with. As a FLO student I think the wiki was fantastic, it took away the alone feeling |
| Not everybody goes on to the wiki on the same day, which is frustrating when you designate one day a week to each subject you are studying. There is so much time wasted waiting and checking for replies. Time is valuable |
| Theme: Technology 19% (n=124) |
| *Subtheme: Technological Skills* |
| After the first attempt it got easier to do |
| [it would have been easier if I had learnt ....] |
| Learning how to use a wiki for starters, although we had used one in another course I still was not confident |
| *Subtheme: Access* |
| Didn't have to be in the same location as the group and being able to access online helped |
| Being on dial up internet |
| *Subtheme: Knowledge* |
| Having a little bit of previous knowledge with wiki's made me feel a bit more confident using it' |
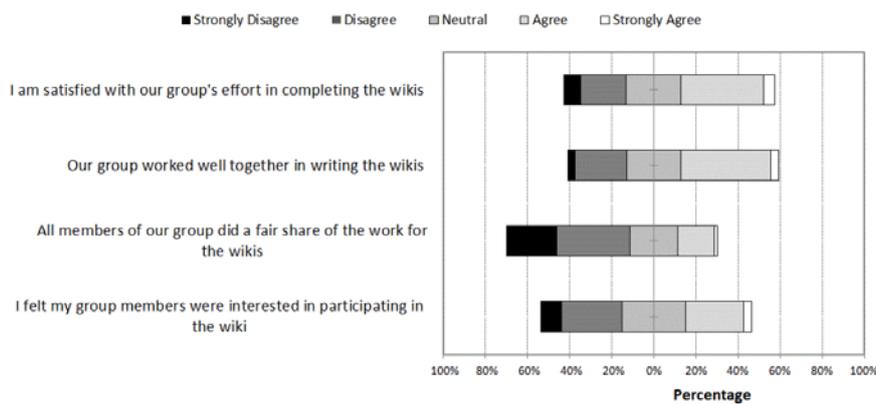
Figure 4. Evaluations of collaborative activities completed during the course

As identified, pre-service teachers' concerns with collaborative working included connectivity between individuals; equal contribution to writing and editing; group organization; and the attitudes of individuals towards the group tasks. However, it was found that these factors appeared to be exacerbated by the fact that the wiki tasks were being assessed. As one pre-service teacher noted;

I put my hand up as editor for some of the tasks and had to tackle with that whole process. I also didn't want to let any of the members of my group down so I tried my best to stay on top of all the tasks. Ultimately I knew

that if I didn't spend some time doing the online tasks I would not get a good mark and I did not want to fail. (#21)

And another:

I find that a lot of the time half the group members do nothing and then leech off the ideas of the others in the group and at the end of the day we come out with the same grade. (#40)

In an attempt to enhance collaboration between on-campus and FLO (flexible learning option), course lecturers purposefully arranged groups to include a combination of on-campus and FLO students. Course lectures believed that the combination of both on-campus and FLO pre-service teachers would provide for a greater sense of community and learning to occur. Prior to completing the wiki tasks the pre-service teachers indicated that they were looking forward to the opportunity to interact with others. Almost half the responses (44%) indicated that they were looking forward to the opportunity to learn from others (social cognitive challenge), whereas 22% identified the social opportunities of meeting new people and being part of a team. Typical responses include:

[I will enjoy] getting a chance to meet new people that I would never usually get a chance to meet. (#48)

When studying in isolation from others you never get the opportunity to have your ideas challenged or enlarged on. It forces you to think through your reflections and conclusions in a logical and clear manner especially when you know that other students will be critiquing your work. (#152)

However, on completion of the wiki tasks it was the collaboration between these two groups of pre-service teachers (on-campus and FLO) that proved to be problematic. Pre-service teachers' perceptions of how each group (on-campus and FLO) worked influenced some groups' ability to work co-operatively and comfortably together.

Some underlying tensions between the two groups emerged as comparisons between on-campus and FLO pre-service teachers were made on a number of occasions by different wiki groups. This was evident in responses such as;

Having groups separate means that on-campus students would be able to arrange to meet to decide in person about workloads etc, while FLO students are more used to online work and lessons and communicating through email. (#6)

As a part-time distance student, I felt I had to 'keep up' with on-campus students which put pressure on me to keep up to date. (#12)

Lots of the time the distance students had already said their part, and done quite a lot so it was hard to find enough to say. (#57)

Pre-service teacher responses indicated that not knowing group members made it difficult to participate confidently and this would have been compounded by the on-campus and FLO groupings. A number stated that it was difficult for people to understand one another's work habits and attitudes. Some pre-service teachers suggested that working face-to-face provided for greater understanding about people and this could help with interpretation of ambiguous contributions when communicating in text only. This was something that was not always possible when working in an online learning environment and was not helped by the organisation of pre-arranged mixed groupings of students who did not know each other.

One participant noted;

There was a strange division between on-campus and distance students and it didn't always make it easy to work well together. (#13)

The wiki tasks were designed to encourage collaboration [13] and course instructors took every opportunity to provide pre-service teachers with support and guidance for working within groups.

Pre-service teachers identified with the role of the course instructor which was to support the groups as they attempted to problem solve their own group dynamics.

[The course instructor provided] positive reinforcement and help our group if there was a certain team member that was very behind. This made it easier for me as I felt that I did not have to take my own valuable time to help her understand what she was doing giving me more time to contribute to the wiki. (#33)

Prior to the course, pre-service teachers believed that the role of the course instructor would have a positive influence in creating the online community ($\bar{x}$ =3.80, SD=0.75, n=67) and supporting their learning ($\bar{x}$ =4.19, SD=0.64, n=67). On completion of the course they acknowledged that course instructors were accessible ($\bar{x}$ =3.37, SD=0.93, n=67) and made an effort to establish a positive community of learning ($\bar{x}$ =3.42, SD=0.98, n=67). When asked how the course instructor influenced their participation in the wiki or forum, the majority of responses (41%) identified affective instructor attributes such as providing support, positive feedback and encouragement. Prompt communication with the instructor (through email, telephone or forum postings) and reminders regarding the course assessments and deadlines were also valued. The positive approach the course instructor took was very important to the students in helping them feel engaged as member of the group and learning community. As one pre-service teacher noted;

Encouraging feedback showing he [course instructor] was observing our activity helped keep me motivated (#63)

3.3.2. Communication

Of the 35 groups within the course, it was evident that some were highly efficient and organised whilst other groups struggled through lack of motivation, leadership and allocation of roles even though clear guidelines were provided. Clearly, group roles made a difference to group dynamics, communication and overall collaboration therefore making it simpler for the students to use the wiki and complete the tasks. One participant said;

It was easier when one woman took the position of leader and delegated specific roles to each member of the group. I am reasonably computer literate so understood what was involved in creating the wiki but I understand that there were others in my group who were not so confident (#150)

Within groups, the distribution of roles appeared to be allocated based on the prior experiences of individuals within the group and the majority of responses reinforced the value in the self-appointed leadership role. The provision of roles within the group made many pre-service

teachers feel more accountable to the group and therefore encouraged better participation. Developing working relationships within the groups was challenging for many students (Figure 5). Those who were not happy with the way their groups worked often cited lack of member interaction within the wiki and in providing feedback to the group. There were frustrations around lack of communication between members of the group and their contributions to the task. As noted by these participants:

Relying on other people with this sort of thing is not easy. Everyone is trying to get their work done and working at different paces, and different subjects. You cannot get immediate answers and therefore it becomes quite disjointed, trying to wait for answers. (#72)

Really hard to get to use the wiki and having others reflect on our work when we have to do it, as opposed to when we ask for it, is somewhat detrimental to learning. Not all people contribute in the same way; sometimes members in groups get the work done early then expect everyone to contribute to the same level as them at the same time. Was difficult to try to interact with the group not having met them, and [been] thrown in the group arbitrarily. (#56)

Pre-service teachers cited that a lack of communication between group members made it more difficult to complete the wiki tasks (Figure 5). They felt less personally connected to wiki group members ($\bar{x}$ =2.67; SD=1.04; n=67) with over half disagreeing or strongly disagreeing with the statement 'I could easily reach the members of my wiki group' ($\bar{x}$ =2.70; SD=0.94, n=67).
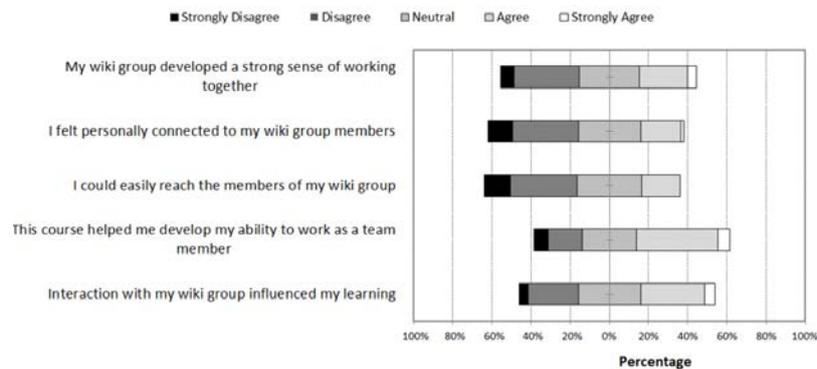

Figure 5. Perceptions of working within a wiki group following the course

The wiki in this Moodle environment did not have a forum facility directly associated with it. Instead course instructors provided access to separate forums for each group as a space where members could engage with one another and discuss the task. The desire to communicate to other group members, as well as the challenge of the asynchronous nature of communication within the wiki environment, was identified by many pre-service teachers. As exemplified by one comment;

I was most frustrated by the fact I found myself sitting at the computer waiting for responses of other members of my group in the planning stages of the wiki. It does not work the same as sitting around a table and having a face to face conversation with a group. It would have been fantastic if there was an online group chat that was available as well as the forums, where everyone can be logged on at the same time as a quicker way to communicate. Even having a Skype programme available to those who wanted to use it. It is just a much quicker, easier way of communicating with people when you have a time period in which you have a job to do. (#32)

Some groups chose not to use the forums provided but established alternative methods of communicating such as using Facebook, email, text messages, Skype, phone and Google Docs. Another aspect of the asynchronous nature of the wiki in the Moodle environment was difficulty faced by pre-service teachers as they tried to communicate with other members of their group through the associated forum. This lack of immediacy with communication led to frustrations among the groups. The main frustration was the amount of time perceived as being 'wasted' through checking in to the forums on a regular basis and the time delays between responses as individuals made their contributions leading to interrupted work patterns.

3.3.3. Technology

Pre-service teacher responses highlighted frustration in learning to use the wiki technology as part of the task. Difficulties reported in using the wiki in this Moodle environment included; functional technology of the web2.0 tool (such as editing, formatting, saving, using links, HTML code and adding images) and the asynchronous nature of the wiki.

The functional technology of the wiki tool caused many pre-service teachers complications. It was described as time consuming and a difficult technology to use, even though the pre-service teachers had identified previous experience and confidence in using word processing tools. For example;

When working on the wiki pages viewed differently to how they were printed, it was difficult to import text, problems with HTML and links occurred (Q16, #266)

Although the wiki was described as not being 'user friendly' because it was difficult to format and edit, pre-service teachers managed to resolve some of these issues by drafting work into other publishing tools and then importing it into the wiki.

The wiki itself became very difficult to manipulate once people had started adding to it. It became very slow and cut parts of other people's additions out and added large white spaces in the page. I ended up cutting and pasting it all into a word document and doing all the editing and spell checking there and then and copying it back into the wiki, which in itself caused problems because the fonts and sizes were not what we wanted.

The programme for editing in the wiki was no good in doing the final touch ups. (Q16, #219)

Initially, the pre-service teachers in this study were fairly neutral when asked how positive they felt about editing contributions and their contributions being edited (Figure 6 and Figure 7). Following the course, the student perceptions regarding editing the wiki had not changed significantly in either case with students still fairly neutral about the editing process.

However, there was a small but significant shift in pre-service teachers opinions about the idea of others viewing their work with more participants feeling positive about their contribution being viewed by others (Figure 8; Wilcoxon Signed Ranks Test z=-1.912, P<0.056, n=67).
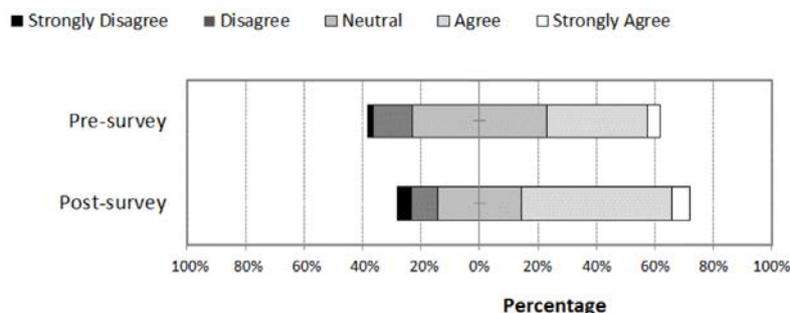

Figure 6. Responses to statement 'I feel positive about others editing my contributions'.
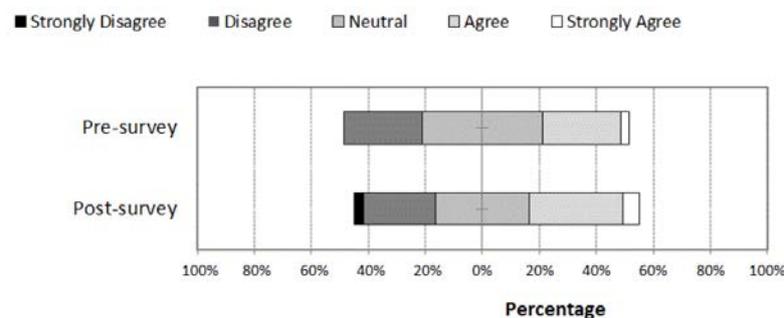

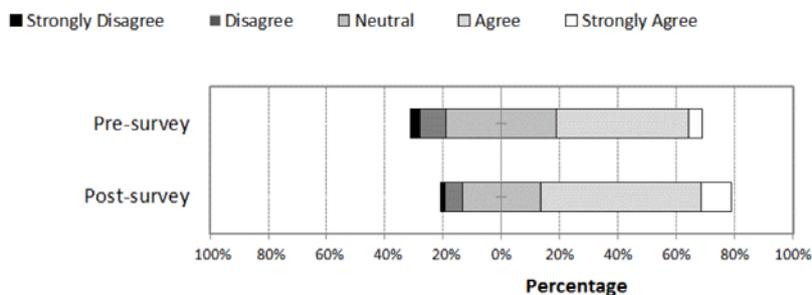**Figure 7.** Responses to statement 'I feel positive about editing others' contributions'

Figure 8. Responses to statement 'I feel positive about the idea of others viewing my contributions'

The idea of manipulating others' ideas and editing other group members' comments was challenging for many pre-service teachers. As one participant noted:

You felt like you were intruding when you were editing others work (#67)

And another said:

I don't feel comfortable editing out others contributions; I feel that through the forum discussions each individual should take responsibility for their own contribution to be edited in relation to comments (#23)

The wiki in the Moodle environment did not allow pre-service teachers to edit at the same time. Working in this type of asynchronous environment caused many frustrations. Some pre-service teachers identified frustrations associated with waiting for group member responses to appear on the wiki and others described how they would spend long periods of time editing and manipulating the text only to find that their work would not save because another person would be working on it at the same time.

.. only one person can edit the wiki at one time. There was several times in the creation of the wikis where some members missed out on adding their part because someone was working on a certain aspect of the wiki...(Q16, #207)

However, many groups worked their way around this problem in ingenious ways. For example they nominated an editor who was solely responsible for manipulating and editing the wiki; others pasted their contributions into the associated forum and from there the work was then moved into the wiki; some used other word processing tools before moving the text to the wiki; whilst other groups started to communicate via social media such as Facebook, where they had conversations and shared ideas before the text was placed into the wiki.

4. Discussion

The very nature of this course assessment was designed to authenticate a collaborative learning experience with web2.0 tools within the context of the science learning area. This study provided a learner perspective on the way pre-service teachers responded to working within a asynchronous learning environment. At the conclusion of their course, they identified working within the collaborative learning space, such as a wiki, as a valuable, positive learning experience.

At the start of the course, pre-service teachers indicated that they had used a range of digital tools, including web2.0 tools, that could support collaborative learning. However, for many the difference was that these experiences of digital tools were novel within a tertiary learning context and we were aware of our students' limited experiences of using collaborative learning tools to support the type of academic learning required at a tertiary level. Bennett, Bishop, Dalgarno, Waycott & Kennedy [2] identified this juxtaposition between the need to provide students with a tertiary learning experience that provided "…creative, critical activities associated with higher education" (p. 532), which is often associated with being exposed to multiple perspectives through collaboration, shared learning and teamwork, and the "…remit of education to accredit individuals through progress towards a qualification" (p.532). Margaryan, Littlejohn & Vojt [32] described how students who face utilising digital technologies, particularly in the application of collaborative or social context, appear to have "…a deficit of learning literacies" (p. 43) and rely on, or are influenced by the pedagogies of lecturers that often require the students to receive information passively. They are simply not familiar, or used to working, with constructivist learning practices [25]. Observations like this are not unusual as literature indicates twenty first century learners are "…somewhat unfamiliar with and reluctant to try collaborative content construction in digital spaces for academic purposes." ([40], p145).

In this study, although new to most students and challenging at times, pre-service teachers were not negative about using wiki as an online collaborative learning approach. However, whilst each group's experiences varied, we identified three main contributing factors that appeared to influence the manner in which pre-service teachers responded to the use of wiki as a collaborative learning tool. These were: developing positive learning relationships; the role of the course instructor; and use of the web2.0 technology.

4.1. Positive Learning Relationships

We identified that following interaction with the wiki, students were still positive about collaborative learning even though there was a significant change in student perception about the reality of working in such a way. The biggest challenges identified by the pre-service students in this study were around the dynamics of working with one another, such as concerns with shared workload, communication, and their roles. The influence of group dynamics on student learning was identified as the most significant barrier to working collaboratively. Although the authors had developed highly structured tasks and

assignments to provide the students with opportunities to develop their technical expertise and, to some degree, cooperative skills, we believed we still needed to be even more explicit regarding the roles and responsibilities and expectations for working effectively within a group.

The tasks were designed for students to learn collaboratively, through a shared responsibility to construct the knowledge to complete the task. However, working collaboratively requires some degree of cooperative learning, therefore for the students to be effective they each needed to be able to work within their group in their assigned roles where each role contributed to the success of the group. It was clear that students in this study valued collaboration, but within this 'high stakes' tertiary environment they were quick to identify those who were not contributing.

It was intended that the online collaborative wiki groups would have the opportunity to establish positive learning relationships just as they would if working in a face to face environment. However, and ironically, one of the biggest issues identified by pre-service teachers was the lack of communication between group members. Initial groupings included a combination of those studying on campus and those studying by distance. Course instructors deliberately chose to mix the groups with the view to building a more collaborative community of learning for all students enrolled in the course. Course instructors made the assumption that the experiences pre-service teachers brought from their respective backgrounds would enhance the overall experience for all involved but this was not necessarily the case, or the way pre-service teachers perceived it. Similarly, course instructors also identified group dynamics as the most significant barrier to students working collaboratively and, given the somewhat complex nature of relationships and the additional challenges and stress that can be put on these relationships when working in an online environment, this was not surprising.

Naismith, Lee & Pilkington [37] identified the significance of the role of the tutor [course instructor] in guiding students as they try to make sense of the process of learning whilst at the same time making meaning of the content. In their study, there were tensions around expectations of collaboration, and students identified that they required more intervention to help them work collaboratively and believed this was part of the tutor's responsibility.

4.2. The Instructor Role

Although the tasks and assignment were structured to further develop collaborative capability, instructors caution about over estimating collaborative competence especially when groups of individuals are brought together for the first time. What might be assumed implicit must be made explicit as individuals learn to be learners in an online collaborative space and as McPherson [36] suggests, sensitises pre-service teachers to the new practices and identities that they will need to adopt for working collaboratively in an online space. It may seem like common practice to suggest using roles to maximise the strengths of individuals but in a deliberate attempt to bring effect to the roles, the requirements of each role,

how and to whom these roles might be assigned should be made explicit.

Although pre-service teachers were operating at a tertiary level it was evident from the outset that if they were going to be successful the role of the course instructor was to ensure that students were supported in managing the collaborative and technological challenges likely to arise in the course. Through encouraging a problem solving approach, and underpinned by the constructivist learning framework, the instructors focused on empowering students to work collaboratively. Course instructors promoted a supportive environment and used their professional judgement to purposefully observe without intervention or decide when to intervene to assist.

In this study, as new and differing challenges occurred, course instructors identified with the importance of the process of critical reflective practice which taken here is defined by Benade [1] to mean "…the on-going, regular and persistent use of reflective tools to engage, individually and collectively, in critical thinking about various aspects of practice" (p.110). This ensured course instructors monitored the quality of teaching and learning and were engaged in a process of continual improvement. Instructors indicated that the process of reflective practice allowed them to add to their own knowledge and learn alongside their pre-service teachers, and maintain a high level of communication with their students.

4.3. Web2.0 Technology

In this study, our pre-service education students were quick to identify the potential pedagogical value of the wiki tool for their own practice. In engaging with the wiki they did identify clear frustrations with the technical skill elements of new technology. Even though the course was carefully constructed with tasks designed to establish development of technical skill, it was clear pre-service students were still being distracted by the functional technology of the tool rather than focusing on the learning task. O'Bannon, Lubke & Britt [40] described how students successfully overcame the interference of technology as they engaged with tasks by providing more practice and instruction. Even so, they discovered in their study that although the students were better prepared for using the wiki as a technological tool, they failed to participate in cooperative learning in their various roles to the extent expected. However, limited prior experiences of technology may not pose as many challenges for students as expected with students quick to develop new skills but at a potential workload cost [2].

Aside from the technical challenges associated with using the wiki, pre-service teachers clearly identified the process of writing in a collaborative learning space as challenging. The notion of providing contributions that will be edited and judged by the group was initially difficult for many students, although at the end of the course there was a significant shift with more students feeling positive about the process of contributing work.

However, pre-service students were still challenged by the process of editing another's work. Maybe the focus in this course was not as much on web2.0 practices such as how to write to a wiki, rather the process of using the wiki as a web2.0 tool [2]. Similarly, Wheeler, Yeomans & Wheeler [51] noted that when working with a wiki "…all contributors should be aware that editing of content is a natural and discursive feature of the wiki, and that collaborative learning requires negotiation of meaning and frank exchange of ideas" (p. 994). While participants in this study were challenged both by the tool and the way of learning, it became clear that some of those skills required to work collaboratively were being applied through different technologies in order to solve their problems. This was seen in the way pre-service teachers used other shared social spaces to generate and edit content as a means of overcoming the asynchronous aspect of working in the Moodle environment. We saw the technological limitations becoming a way for the participants to express those skills required for effective collaborative learning.

5. Conclusions

Evidence suggests that wikis have potential for facilitating collaborative learning in the online environment [15,17,36,43] but studies have also identified varying degrees of success [3,18,31,38,40,52]. A large number of pre-service teachers were involved in the pre- and post- phases of this study and have indicated that, despite the challenges, their experiences were still positive. Predetermined and explicit teaching associated with both technological and collaborative learning has been identified as a key component of both participation and wiki contribution. Based on these results it is also evident that course instructors' perceptions of what they believe makes a useful group dynamic, such as a mix of on campus and distance students, may not be consistent with pre-service teachers views and thus greater understanding is required.

In acknowledging the experiences of pre-service teachers, course instructors are promoting the role of reflective practice to gain better understanding of the pre-service teachers' perspective. Other studies have explored some of those challenges when using web2.0 tools in an online collaborative environment (for example [40]). The results of this study provide further evidence to support our previous findings [12,13] along with some key recommendations associated with: the role of the instructor; group roles; and the explicit approach to teaching about the skills and attitudes for working effectively in an online collaborative environment. We did not explore the level of achievement gained from this experience but we can anecdotally acknowledge a much higher academic level of work produced by pre-service teachers involved by the end of study.

Future recommendations for further study include a specific focus on student learning, where the relationship between collaboration in an online environment and achievement is explored in more detail. Also relevant and of interest to the field would be a more intricate study on the teaching and learning dispositions that support collaboration through the use of a web2.0 tools such as wiki. Our investigation makes clear that teacher educators must facilitate a learning environment that encourages pre-service teachers to become more aware of their own dispositions. We believe that this should be systematically conducted throughout initial teacher education programmes and explicitly linked to their related practice experiences in schools.

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