Innovative Methodologies for 21st Century Learning, Teaching and Assessment: A Convenience Sampling Investigation into the Use of Social Media Technologies in Higher Education

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Abstract

The advent of the Web as a social technology has created opportunities for the creation of informal learning environments, which have potential for innovative methodologies in learning, teaching and assessment. However, as Wolfe (2001) admonishes, "contrary to the rhetoric of cheerleaders, the Web places greater demands on students than traditional modes of instruction" (pp. 2 – 3). The pedagogical potential of these high tech, e-skilling, multimedia digital technologies to revolutionize teaching, learning and assessment will only be realized if the underlying theoretical foundations are well articulated and supporting evidence is provided through well-designed empirical research studies.

This paper contributes to these two prospects in two ways. First, it articulates the theoretical framework drawn from the work of luminaries in pedagogy that posits cooperative, social learning strategies, as potential methodologies for effective pedagogy. Second, it describes the results of a convenience sampling case study, which investigated the use of cutting-edge social media technologies, namely Google + Discussion Circles, (GDCs), to shed some light on how the use of these social media technologies supported teaching, learning and assessment activities for 2nd year Bachelor of Education students at a university in Australia.

The research found, inter alia, that when students were given the opportunity to learn using GDCs, the majority took advantage of the academic, social and structural dynamics created by these technologies in many ways that supported their learning, assessment activities and overall academic outcomes. The research-based evidence shows that the benefits included high participation rates, great levels of interpersonal interactions among participants, pedagogically rich posts in the GDC streams, metacognitive processing, peer mentoring, ambiguity tolerance, anxiety and motivation. There was also considerable student engagement, exploration of issues, elaboration of what was being discussed in the GDCs, evaluation and explanation, consistent with Bybee et al. (2006) 5E Instructional model for supporting and maximizing students' learning. The evidence leads to the recommendation that pedagogues at universities and other institutions of higher education should explore opportunities for utilizing selected social media technologies in their pedagogical practices, because, if properly planned and implemented, these technologies appear to have potential so support effective learning, teaching and assessment in the 21st century. Further research on this topic could also be very beneficial.

Keywords: Web-based learning technologies, Social media technologies, Active learning participation rates, Cooperative learning, Field dependence, Learning styles, Academic performance

1. Introduction

1.1 Contextualizing the Problem and Its Significance

The advent of the Web as a social technology has created opportunities for the creation of informal learning environments that have potential for innovative pedagogies, but as Wolfe (2001) admonishes, "contrary to the rhetoric of cheerleaders, the Web places greater demands on students than traditional modes of instruction" (pp. 2 –

3). Informal learning environment is used here following the National Science Foundation Informal Science Education Program (NSFISEP, 2000), which defines it as one in which the learning that occurs is:

> *voluntary and self-directed, life-long, and motivated mainly by intrinsic interests, curiosity, exploration, manipulation, fantasy, task completion, and social interaction. Informal learning can be linear or non-linear and often is self-paced and visual- or object oriented. It provides an experiential base and motivation for further activity and learning. (NSFISEP, 2000, paragraph 1)*

If Web-based, cutting-edge technologies, such as Google + Discussion Circles discussed in this paper, are to be used effectively in such environments to meet the cognitive demands of learners and to support the instructional strategies of pedagogues to facilitate learning, teaching, and assessment, they must be designed and taught well to students, applying well-researched strategies. Unfortunately, although the use of Web-based, social media technologies has become ubiquitous outside academia, their use in learning, teaching and assessment is in its infancy. As a result, "there is a desperate need for good research about learning and teaching on the Web and rigorous assessment of Web-based courses" (Wolfe, 2001, p. 15). Only when we are informed by valid and trustworthy research on the effectiveness of using new Web-based technologies in pedagogical practice shall we gain an understanding of the enormous potential of Web-based technologies, such as social media technologies, to support learning, teaching and assessment in the 21st century classroom and lecture theater.

This paper reports the results of a good piece of research which investigated the use of selected social media technologies, namely Google + Discussion Circles (GDCs), to support learning, teaching and assessment of two cohorts of 2nd year Bachelor of Education students at a university in Australia, in 2014. The research was encouraged by the findings of two earlier informal studies, which used GDCs with a doctoral cohort of students and two 2nd year B-Ed students over two years (Kivunja, 2012; 2013). That earlier experimentation found, inter alia, some 12 encouraging points which included increased personal interest of learners, taking initiative to extend learning, greater engagement, deeper and more higher-order critical thinking by the students, greater connectedness to other learners, sharing ideas and resources, and peer mentoring and support. The findings led this researcher to believe that if well planned and implemented as innovative tools for learning, teaching and assessment, the use of GDCs social media technologies offers promise to support pedagogical practice in the 21st century in many ways. For example, it can facilitate the tailoring of educational experiences to individual students' interests. Second, it has potential to maximize Vygotskyian learning as a social act (Vygotsky, 1929) with sharing of ideas and resources. Third, it can create opportunity to harness the advantages of Kagan's (1994) five principles of cooperative learning, through the use of peer learning networks (PLNs) in virtual learning communities. Fourth, it can create opportunities for critical thinking and cognitive flexibility in which students can get exposure to a wide variety of learning environments. Fifth, the use of GDCs offers opportunity for training in perception, memory and metacognition. Six, as also noted by Wolfe, (2001), using Web-based technologies in teaching is very well suited to promoting critical thinking, scientific reasoning and what Albert Einstein called "the enjoyment of seeing and searching" (Henniger, 1987, p. 169). Finally, as a social technology in an informal learning environment, it offers an innovative methodology for 21st century learning, teaching and assessment, comprising not only technology but also connectedness to other learners, learning goals and instructional design. Spurred on by these beliefs, a formal research project, authorized by the Human Research Ethics Committee of the university involved, was conducted with the 2nd year B-Ed students in 2014 the results of which are reported in this paper.

2. Pertinent literature and theoretical foundations underlying social learning

What do luminaries in the field say about learning as a social act, or in teams or in peer learning networks (PLNs) driven by technology? Is there a pedagogical theory or theoretical perspectives that support the use of social structures to enhance learning? Both these questions are explored in this section to provide a theoretical foundation for this paper. These questions are important because as Kivunja (2012) points out, whereas the advent of social media sites such as Facebook, Twitter, MySpace and Bebo was warmly embraced for application in recreational and conversational interaction, (Kaplan & Haenlein, 2010), mainly for fun and humour, their application in orthodoxy educational settings has been more challenging and sometimes controversial. The use of social media in pedagogical practices is often treated with disdain or scepticism based on "tehnophobia which is unwarranted" (Kivunja, 2012, p.1). This section highlights literature that offers several theoretical frameworks that support learning as a social act, or the use of social media technologies, and social structures or networks, to support learning, teaching and assessment.

A large body of evidence from research by luminaries in the field, including Piaget (1923), Vygotsky (1929), Lewin's (1948), Bruner (1966), Gardner (1983), Biggs (1985), Ramsden, (1992), Johnson and Johnson (1994), Kagan (1994), Entwistle (2000), Anderson (2001), Prensksy (2001), Wolfe, (2001), Sherman (2001), McCain (2007), Tapscott (1998,

2009), Kelly, McCain & Jukes, (2009) as well as Trilling and Fadel (2009), indicates that there are very solid grounds for designing innovative digital methodologies based on learning networks to support learning, teaching and assessment. For example, Sherman (2001) categorically states that "the constructivist theories of Piaget and Vygotsky are widely acknowledged as significant foundations upon which to build peer learning experiences" (p. 114). This is because these cognitivist theorists developed the understanding that learning is a social experience rather than an individual one. Guided by this theorisation, they argued that "the social occasions of conversation, discussion, joint work, groups, and debate play a critical role in learning" (Wilson & Peterson, 2006, p. 4). Sherman (2001) explicitly argues that the use of computer supported collaborative learning environments, such as PLNs, has potential to facilitate the process of "intersubjectivity in which learners communicate in a reciprocal process of discourse and engage each other's construction of credible reality" (p. 122). Thus, social media technologies, such as GDCs, which create social occasions among students for conversation, discussion, and sharing resources in the streams in the GDCs, in reciprocal processes of discourse, as postulated by Sherman (2001), appear to be fully consistent with these cognitivist theories of how people learn.

Following Kurt Lewin's (1948) work on the resolution of conflict several of his students, including Deutsch (1949) showed that when students were organised to learn in cooperative structures, they achieved learning outcomes that were significantly higher than those who learnt in competitive arrangements. Other Lewinian cognitive psychologists such as Johnson and Johnson (1994) subscribe to action theory which postulates that human behaviour is a result of the interactions of persons with their environments. For example, they propose that "when you generate an action theory from your own experiences, and then continually modify it to improve its effectiveness, you are learning experientially" (Johnson & Johnson, 1994, pp. 16 – 17). They argue that such learning is very powerful because it affects the learner in a cyclical process involving taking action, experiencing consequence and re-organising information to improve cognition.

In an earlier publication Johnson and Johnson (1987), provided an explanation, which appears to be very supportive of the power of instructional methodologies based on PLNs to have a very positive influence on learning. They argued that such methodologies have potential to promote high level learning, particularly among adult learners, because of, inter alia, the following Lewinian six principles (Johnson & Johnson, 1987, pp. 18 – 20):

i. Effective experiential learning will affect the learner's cognitive structures (action theory), attitudes and values, perceptions and behavioural patterns.
ii. People will believe more in knowledge they have discovered for themselves than in knowledge presented to them.
iii. Learning is more effective when it is an active rather than a passive process.
iv. Learning takes more than information and change action theories, attitudes, and behavioural patterns.
v. The more supportive, accepting and caring the social environment, the freer a person is to experiment with new behaviours, attitudes and action theories.
vi. In order to change behaviour patterns both the person and the social environment have to change.

Thus, innovative instructional methodologies, which encourage students to learn experientially, especially through cooperation with others in their PLNs, as indeed in the case in the use of GDCs, are fully consistent with Lewin's (1948) cognitive action theory as proposed by Johnson and Johnson (1987; 1994).

Like Deutsch (1949) and Johnson and Johnson (1994), Schumuck and Schumuck (1992) also strongly advocate the use of instructional methodologies which encourage students to work in PLNs. Their review of research on the use of group work and cooperative learning strategies concluded that such methodologies facilitate deep learning. In *Learning together and alone,* Johnson and Johnson (1975) also agreed with this view when they concluded that instructional methodologies that involve cooperative learning strategies were highly effective in improving academic achievement.

The use of non traditional methodologies, such as social media technologies, which allow learners to approach learning from their personal perspectives is supported further by learning styles researchers such as Biggs (1985), Gardner (1983; 1999; 2006), Kolb (1984) and Anderson (2001). Their research indicates that there are reliable individual differences among learners, which influence their ability to learn, and so learners learn differently, exhibiting different learning styles. For example, along this line of thought Anderson (2001) provides evidence, which suggests that Gardner's visual learners tend to learn and to derive significant cognitive benefits from multimedia presentations. Anderson (2001) further suggests that Gardner's interpersonal learners, whom he (Anderson) calls field-dependent

learners, who tend to attribute their success in learning to external influences and rely on external locus of control, tend to learn more from hypermedia, such as social media technologies driven by GDCs, which depend on interpersonal interactions. Instructional methodologies which create opportunities for students to learn in interpersonal relationships, allow students to share each other's views, challenge each other's ideas and to develop deeper pedagogical content knowledge (Kagan, 1994). Furthermore, Biggs (1985) found that such learners are more inclined to engage in deep rather than surface learning. Deep learning needs to be encouraged because, as Entwistle (2000) explains:

> *In the deep learning approach, the intention to extract meaning produces active learning processes that involve relating ideas and looking for patterns and principles on the one hand (a holistic strategy), and using evidence and examining the logic of the argument on the other (serialist). The approach also involves monitoring the development of one's own understanding.(p. 3)*

In essence, when students are engaged in deep rather than surface learning (Entwistle, 2000; Entwistle & Tait, 1990; Ramsden, 1992; 2003), they engage in critical analysis of new ideas that they encounter, link those ideas to concepts and principles that they already know, and through this process gain a deeper understanding and long-term retention of concepts and ideas so that they can then apply them in problem solving in new contexts (Biggs, 2003; 2006; Johnston, 2014; Lublin, 2003). This way, deep learning improves understanding and enables application of what is learnt for life. For example, in their research, Marton and Saljo (1976) found that students engaged in deep learning look at the significance of what they are being taught or what they are reading and try to figure out what it really means in light of the totality of the information on the topic, in a holistic way. They interpret the content in their own way, by integrating the information with what they already know or their current schema. This provides for what Piaget (1954) called adaptation, resulting from either assimilation (if the new information is congruent with their current schema) or accommodation (if the new information requires the existing schema to change to a new one to make sense), and the students can develop critical thinking and commit to long-term memory what they learn. Thus, if students are given opportunity to use technologies which enhance deep learning, they can actively engage in deep cognitive processing, studying content with a primary focus on learning its purpose, significance and real meaning. They can reflect on what they have learnt, apply it to real life situations and make connections and analyse and evaluate and synthesise what they have learnt. Hence, any technologies that enhance deep learning should be encouraged because they help students to be involved in authentic learning in which they work at Bloom's (1956) higher-order cognition processing levels. As Wilhite (1990) found, when students engage with their learning at such cognition processing levels, they demonstrate greater achievement in their academic outcomes. Giving students the opportunity to work in their own networks assumes and provides for heterogeneity among learners, consistent with Gardner's (1983; 1999) multiple intelligences. Student-centric approaches can therefore be said to be better suited to providing for the diversity and inclusivity of students. Moreover, student-centricity is enhanced when students learn with each other at times of their own choosing that are convenient to them on a 24/7/365 basis.

Furthermore, research by Wolfe et al. (1998) showed that when students were given opportunities to learn using on-line interactions, they experienced a greater sense of community engagement, more intellectually enriched exchanges and there was also the creation of rich feedback networks among learners. Moreover, in support of using Web-based technologies Wolfe (2001), says that "the Web is well suited to dynamic displays and systemic visual analogues of complex relationships. More broadly, the Web is a medium for concretising abstractions" (p. 10). Further support for the use of PLNs as innovative methodologies in pedagogical practice is provided by Sherman (2001) who considers such technologically enriched PLNs to be consistent with the cooperative learning goal structures, which are believed to be more influential on learning than individualistic, or competitive goal structures. Many luminaries in the field share this belief. For example, Johnson and Johnson (1989) in a major study that analysed nearly 900 studies that had been conducted over 90 years about the effectiveness of cooperative learning in promoting productivity and achievement among students, found that on average, cooperative learning produced above average student learning. The study also found that compared to individualistic or competitive learning, cooperative learning "resulted in more higher level reasoning, more frequent generation of new ideas and solutions, and greater transfer of what is learned within one situation to another" (Ibid, p. 5). Moreover, students taught using cooperative learning structures were found to have enjoyed learning and to like schooling more than those taught in individualistic or competitive contexts.

The use of technologies that support collaborative learning is supported further by Mariani's (1997) model, which showed that collaborative activities promote high engagement of students and this leads to quality learning. Similarly,

Mercer's (2002) research among Mexican teachers found that the more effective teachers, who helped their children achieve the most learning outcomes, were those who provided scaffolding for them to work together. Additionally, Goleman's (1996) research showed that engagement in cooperative learning activities helps students develop their emotional intelligence. Likewise, Kutnick's (1988) work concluded that putting pupils into groups enables them to learn very effectively with collective reinforcements, and more effectively than in individualistic or competitive situations. In classroom management, Glasser (1990) found that the use of cooperative learning strategies increases students' on-task behaviour and improves classroom management. These attributes help to create a better learning environment.

What's more, research studies by Slavin (1988; 1996) and Abrami and Chambers (1996) suggest that the reasons why innovative instructional methodologies based on cooperative learning strategies offer a lot of promise for effective learning, teaching and assessment rest on four theoretical dimensions, which they call:

- Motivational dimensions
- Social cohesion dimensions
- Cognitive developmental dimensions; and,
- Cognitive elaborations dimensions.

It helps to unpack each of these briefly, so that it is easier to appreciate how they can be beneficial in instructional methodologies that emphasize the use of PLNs. To explain the motivational dimensions, these authors suggest that when you use cooperative learning, students learn because of what they call outcomes motives, means motives and interpersonal motives. Outcomes motives are the results of rewards, recognition or satisfaction from the achievement of the learning goals. Means motives arise out of students' intrinsic interest in learning. Interpersonal motives arise out of peer mentoring and support. As for the social cohesion dimensions, Slavin (1996) says that these refer to the fact that "students will help one another to learn because they care about one another and want one another to succeed" (p. 46). For the cognitive development dimensions, these authors suggest that students engaged in cooperative learning provide learning and thinking scaffolds for each other. This way, they help each other extend their ZPD. The cognitive elaborations dimensions align with Piaget's (1954) notion of assimilation and accommodation. They suggest that in cooperative learning, students restructure their schema in light of the contributions made into their GDCs streams. As they assimilate the new ideas from their peers they advance their understanding to new frontiers through assimilation or accommodation. Thus, from both theoretical and pragmatic considerations, leaders in the field agree that applying instructional methodologies, which utilise cooperative learning, in social contexts, has potential to influence learning significantly. Sherman (2001) puts it more emphatically when he says that peer learning in technologically enriched behavioural settings offers innovative instructional methodologies that can improve human relations, as well as provide for more efficient acquisition of knowledge and problem solving among PLNs of diverse learners. He argues that the use of new computer-supported technologies, (such as GDCs), provides a medium through which collaboration among PLNs can be facilitated.

Given the penetration of social media technologies in the lives of students outside school, not only of those that Mark Prensky (2001) calls "digital immigrants" (p. 3), but particularly those that Don Tapscott, (1998) calls "The Net Generation" (p. 15), it makes a lot of pedagogical sense to use these innovative technologies in learning, teaching and assessment in school contexts. Not only is this consistent with the constructivist philosophy of student-centric active learning (Piaget, 1923; Vygotsky, 1929), and participatory learning, Bruner, (1966), but also with authentic pedagogy (Flewelling & Higginson, 2002; Gulikers, Bastiaens, & Kirschner, 2004; Muijs & Reynolds, 2011; Wiggins, 1990; 1993;). The more we can create learning, teaching and assessment environments that are similar to the conditions beyond school, college and university where our students live, work and study, the more student-centric, more student-participatory, and more authentic our pedagogical practices will become. As Lankard (1995) very eloquently pointed out, it is important to make classroom learning experiences more authentically congruent with the experiences of learners in the technologically enriched conditions beyond the classroom environments since doing so will make the innovative methodologies more student-friendly and pedagogically more effective. Moreover, in a synthesis of *Theoretical perspectives of how Digital Natives learn,* Kivunja (2014) concluded:

> *The Digital Natives have grown up collaborating, sharing information and creating together online. The old way of learning along a do-it-on-your-own attitude simply doesn't make sense to them….*
>
> *Therefore, the old individual learning model does not help Digital Natives to learn" (p. 104)… the way we can help Digital Natives learn is not by trying to teach them the old way [but] … to change the way we*

> *teach and what we teach… In sum, teachers/educators should learn to communicate in the language and style of the Digital Natives.* (p. 104)

As Tapscott (2009), warns, "students won't be prepared for the world of today unless schools use technology to implement real change to their model of education" (p. 144). That real change can be facilitated by the introduction of social media technologies which, as noted above, are the preferred media platforms for collaboration, sharing information and critical thinking among learners of the 21st century classroom. This is supported by Siemens (2004) who proposes the connectivist paradigm to extend an understanding of how learning occurs among digital learners. The connectivist paradigm postulates that the construction of knowledge occurs through networked connections among participants digitally connected in a learning community. The connections enable the learners to find the knowledge that they need to make sense of a given situation. Thus, the use of PLNs, as experienced in GDCs, gives students opportunities to work in Web- based connections which enable students to utilise the connectivist paradigm not only to *know-how* and *know-what* but also to *know-where* by individually taking the initiative to search for information and then sharing it asynchronously with their PLN. This sharing through PLNs is supported by Howell (2012) who directly advocates a collaborative epistemology in which learning is facilitated and amplified through collaborative activities using social media technologies. Howell (2012) argues that learning takes place, not through data bases, but through social interactions connected through the Internet. Contrary to orthodoxy thinking, Howell (2012) presents the understanding that social media are useful not just for social conversation, but also for active learning of pedagogical content and for completing formative assessment in collaborative PLNs.

The views of luminaries expressed in the literature reviewed in this section provide a well grounded theoretical foundation that looks favourably at the potential value of innovative instructional methodologies designed to use social media technologies, to support learning, teaching and assessment. These methodologies create opportunities for students to learn together in cooperative rather than competitive or individualistic structures. The literature suggests that the use of such innovative methodologies appears to be more conducive to student engagement in active learning, participation, higher-order cognitive processing, and overall knowledge construction. Thus, the literature reviewed leads to the conclusion that the use of social media in pedagogy is fully consistent with the theories of learning advanced by luminaries in the fields of pedagogy and e-skilling. The theories provide consensus that children learn best when they are given opportunities to co-construct knowledge through social interactions. They learn better through social interactions than they would learn on their own.

3. Methodology

3.1 Research Design

The design of this study was informed by Anderson's (2001) "Interactive model of learner characteristics and Web-based course" (p. 66) illustrated in Figure 1 and briefly outlined here. The model comprises variables in three columns shown as A, B and C. Column A shows the attitudes, core characteristics, and knowledge of learners. In column B are represented the Web-based course elements, which include how the course is designed, opportunities to scaffold and to control students' learning, both by the instructor and by peer learners through their PLN activities; the level of prompting the learning activities by the instructor (lecturer), assessment, feedback and overall learning task analysis by the instructor. The learning outcomes expected to be achieved by students who complete this course are represented in column C. These include not only academic performance by participants, but also their satisfaction with the Web-based learning activities and experiences, whether they like or dislike the experiences, and whether they are happy with how their learning is supported when they are engaged in Web-based learning. The variables are illustrated in the three columns (A, B, and C), to simplify the description of the model, but in reality, they represent "the interaction of the individual, the course design and the outcomes of the Web-based course" (Anderson, 2001, p. 65) in interactive and interrelated relationships, which make the complete model holistic and dynamic, as illustrated by the arrows.

3.2 Research Questions

Using this model as the basis for the design of this study, the research sought to investigate the following five major questions, divided into ten sub-questions, each of which represents a variable in the Anderson (2001) model as outlined below:

1. When students are given opportunity to learn using GDCs social media technologies:
    a. What evidence of 'field dependence' (explained in 5.2 below) do they demonstrate?
    b. What participation rates do students demonstrate when engaging in GDCs stream posts?

c. Is there evidence that when students are engaged in a Web-based, asynchronous learning unit, they assume greater control of their learning?

d. Which learning styles do students that learn using GDCs demonstrate?

e. Does the material shared in the GDC streams demonstrate any of the following learner characteristics:

i. Self-regulated learning,

ii. Metacogntion,

iii. Ambiguity tolerance,

iv. Anxiety,

v. Motivation?

2. What do students engaged in learning with GDCs social media technologies say about their experiences of using these technologies?

3. Does the data presented in the GDCs streams provide any evidence that sheds some light on how the use of GDCs social media technologies supports students' academic performance?

4. How do students engaged in learning using GDCs social media technologies respond to or use feedback and peer mentoring?

5. How does the use of GDCs social media support learning, teaching and assessment overall?

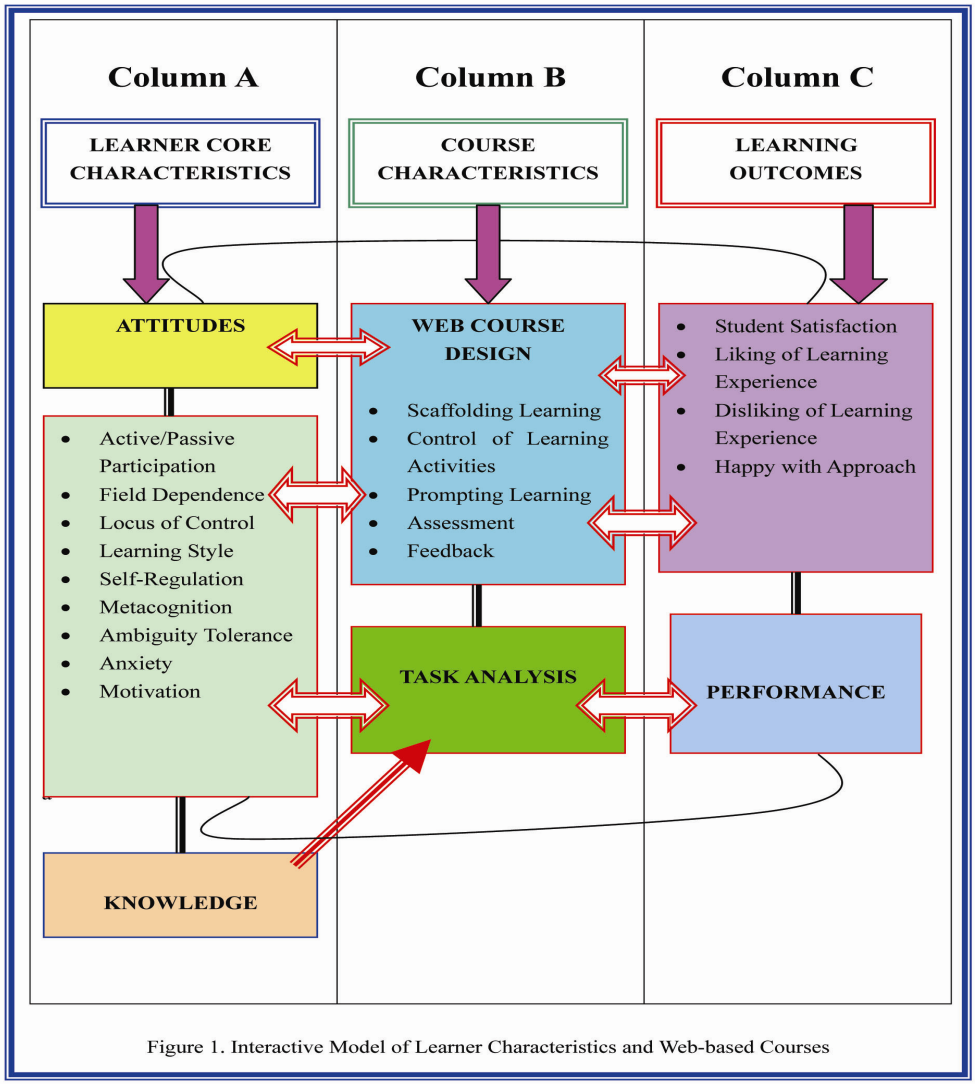


Figure 1. Interactive Model of Learner Characteristics and Web-based Courses

3.3 Participants, Sample Sizes and Sampling Procedure

The study was designed as a case study (Merriam, 2001; Smith, 1978; Yin, 1994), consisting of students enrolled in two cohorts of a 2nd year Bachelor of Education Unit in the second trimester of 2014 at a university in Australia. One cohort was internal (n = 60) and the other external, (n = 85) giving a total population of 145 participants in the Unit in the second trimester of 2014. The trimester ran from the end of June 2014 to the end of October 2014. Although the trimester ran for 13 weeks, students participated in the GDCs learning activities only during 9 weeks because students were expected to be out on professional practice in different schools for four weeks of the trimester.

3.3.1 Sampling Procedures

The "convenience sampling procedure" (Cooksey & McDonald, p. 470), was used in selecting the participants because of the ease of the researcher's access to these cohorts of students and their willingness to participate in the study. Clear advantages of this sampling procedure included the availability of participants, the ease with which participation could be observed and monitored, and the quickness with which the data could be gathered for analysis. The internal cohort (n = 60) randomly formed groups ranging in size from 4 – 6. These groups were treated as random samples, because any student could join any group. On this basis, the internal cohort created ten samples with n values of 6. There were only 6 male students in this cohort. These randomly assigned themselves to different samples, without being instructed to do so by the lecturer.

The external cohort (n = 85) were asked first to form a random group of 10 in the learning management system called Moodle, and then use that sample as the basis for building a PLN using GDCs social media technologies. Students were given instructions in Moodle to help them set up gmail accounts and individual GDCs that they were to share. There was no limit on potential participants in any of the PLNs. The PLNs were "purposively sampled" (Burns, 2000, p. 465; Cooksey & McDonald, 2011, p. 462), like this, to allow for maximum participants and interactions among PLNs utilizing the dynamics of social media, as represented in Figure 1. Students were encouraged to participate in the GDCs, but participation was voluntary and by mutual and reciprocal invitation. This meant that a participant in a PLN initiated a GDC and then invited others into their Circle. The invited participants responded through a similar process. This design made GDCs the preferred social media platform over Facebook because it gave all participants greater control of whom they interacted with in cyberspace. Also, in posting into the stream of each GDC, participants were urged to always make sure that they chose the 'Share in Private' option rather than 'Share Publicly' so that they could exercise some control on field dependence. The use of GDCs was also considered to be superior to Twitter because GDCs, unlike Twitter, set no limits on either textual characters, graphics or resources that participants can post into the stream.

3.3.2 Ethical considerations for participants

The researcher sought and was granted permission to conduct this study by the Human Research and Ethics Committee of the university at which this study was conducted. Assurance was given to participants that their participation was voluntary and that there would be no deleterious consequences on their studies if they chose not to participate in the study. They were also informed that to safeguard their privacy, their names or identities would not be divulged. If they chose to participate in the study, they were to indicate their consent by creating a special gmail account, sharing it with other participants in Moodle, creating a GDC and sharing it with participants, in 'Private' Google space.

4. Data gathering and Analysis

4.1 Data Gathering

The data were gathered from students' and the lecturer's postings into the GDCs streams. These included instructions and feedback on weekly activities from the lecturer, students' personal comments, responses to their peers' posts and to the lecturer's instructions and feedback, resources that the students imported from texts on the pedagogical topics that were being learned each week, textual reactions to the teaching strategies taught in the lectures and discussed in the GDCs streams, and YouTube sourced clips relevant to the topics studied. Additionally, students were encouraged to use their own smart phones and eTablets to take photos and capture any images which they thought were helpful in understanding the pedagogical content and developing pedagogical knowledge about the topics being studied, and post these resources in the streams to share with their GDCs driven PLNs. The data were not restricted to the postings by students in one GDC stream, but also included the postings of their peers that they had invited from outside their own PLN.

4.2 Data analysis

Data analysis was guided by the research questions stated above and focused on the following ten variables of Anderson's (2001) model illustrated in Figure 1.

i) Participation rates as observed from posts in the GDCs streams,

ii) Evidence of field dependence, (explained in section 5.2 below),

iii) Assumption of control of learning,

iv) Learning styles demonstrated,

v) Evidence of self-regulated learning, and metacogntion,

vi) Ambiguity tolerance, anxiety, and motivation,

vii) Expressions of satisfaction/like or dissatisfaction/dislike or happiness about the learning experiences,

viii) Statements in the GDC streams about how the use of GDCs social media technologies scaffolds and/or supports/prompts their learning,

ix) Evidence of response to feedback from the lecturer, and peer mentoring,

x) Overall analysis of how the use of GDCs social media supports knowledge construction, learning, teaching and assessment (performance) outcomes?

The results of the analysis are discussed in the following section, under ten subheadings, which correspond to these ten variables.

5. Results

In the discussion of results, frequent reference is made to the master GDC which was used by the lecturer to monitor all the conversations and learning activities that took place and whatever resources were posted in the streams of all the different GDCs. For the external cohort, that GDC was code named EDLT219-2014-1 and is illustrated in Figure 2. In this code, [EDLT219] is the descriptor for this 2nd year, Bachelor of Education Unit in Learning and Teaching; [2014] refers to the year of enrollment in this Unit, and the [1] is the identifier for the external cohort. The internal cohort had the full code EDLT219-2014-2. However, the results discussed here refer only to the external cohort – EDLT219-2014-1, as it would have been too much data to discuss the results of both cohorts in one paper.

The individual GDCs that were set up by the students were given the code PLNCKi-EDLT217/9. In this code, [PLN] stands for Peer Learning Network. [CK] refers to the initials of the lecturer that conducted this Unit and the [i] is the numerical descriptor of the particular PLN. The descriptor of each PLN ends in a [7 or 9], depending on the course rules that students were enrolled under. Two examples of the students' GDCs, - PLNCK4 and PLNCK1, - are illustrated in Figures 3 and 4, respectively, to facilitate reference to them in the discussion of results.

In these Figures, and in any data obtained from the GDCs streams and used in this paper, the names of individual participants are blotted out and the photos blurred so as to protect the identity of participants and to uphold their anonymity as prescribed by the Human Research Ethics Committee that authorized this study. Additionally, pseudonyms are used in the discussion, rather than the participants' real names, to safeguard the privacy of participants.

Figure 2. Master Google Discussion Circle – EDLT219-2014-1

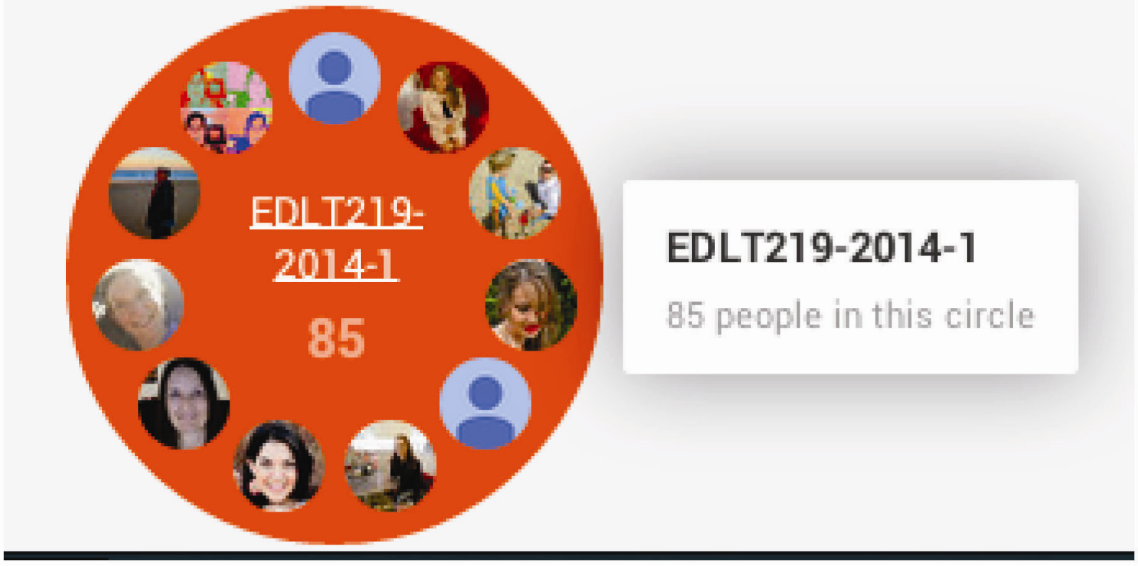


Figure 3. PLNCK4-EDLT217

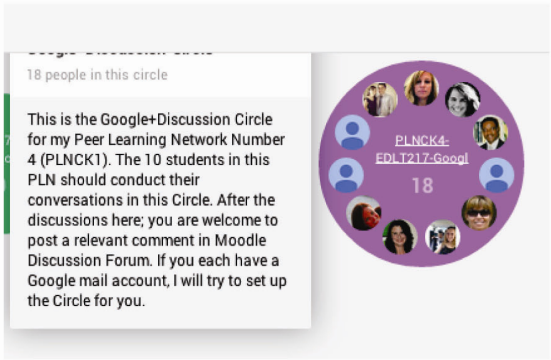
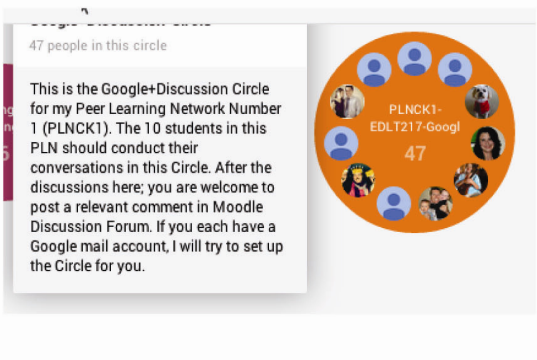


Figure 4. PLNCK1-EDLT217



As illustrated in Figure 2, the master GDC, EDLT219-2014-1 had all the 85 students (n = 85) enrolled externally in this Unit in 2014. Figure 3 shows the GDC for PLNCK4 which started out with a core of 10 participants but grew to 18 as a result of the GDCs multiplier effects (GDCME), which will be discussed below. Similarly, Figure 4 represents the GDC for PLNCK1, whose participants grew from the original 10 to 47. Discussion of the dynamics observed in all the GDCs is presented below along the ten variables of Anderson's (2001) model outlined earlier, and the ten research questions derived from that model, in the following sections 5.1 to 5.10, respectively.

5.1 Participation rates in GDCs stream posts (variable 1)

In this variable (variable 1), the study was interested in the number of participants in each GDC, and how often individual participants revisited their GDC and posted data or resources in the stream. The study found that across all the PLNs, in the master GDC - EDLT219-2014-1; when students were given the opportunity to study using GDCs, the participation increased by a multiplier factor that varied between 160% in PLNCK5 which was least active, and 470% in PLNCK1, which was most active. The study observed significant divergences in the level of participation across the different PLNs, but as illustrated in Figure 3, the GDC of PLNCK4 realized a multiplier effect of 180%

and the GDC of PLNCK1, illustrated in Figure 4, enjoyed a very high multiplier effect of 470%. What these numbers mean is that PLNCK4, like any of the other PLNs started out with a core membership of 10 students. These then invited students from other PLNs and as a result, their PLN size increased from 10 to 18 participants. This represents a GDC multiplier effect (GDCME) of 180%. Similarly, PLNCK1 started out with a membership of 10 but when these members used the GDC to invite their peers, the participation grew to 47 members; representing a GDCME of 470%. These results are particularly interesting when you consider that participation was voluntary and by reciprocal invitation. It is important to note that these numbers varied across the trimester, as students joined or left their GDC at will. This means that a different participation rate could be observed for the same GDC, depending on the particular day and time it was accessed in Google.

The GDC software automatically shows the number of times each bit of data or resources that are posted in the GDC stream are viewed. Also shown is exactly who visited the GDC, and what they posted in the stream, including the time of doing so. The data showed, that over the 9 weeks of the trimester when students were engaged in learning using GDCs, they made a total of 42,114 visits. These data could be used to count the exact number of times each of the students participated in their GDC. That option was not followed since it would be very laborious. Instead, a simple mean participation rate was calculated, showing that over the trimester, each participant made 495 visits (42,114/85). This works out at an average participation rate of nearly 8 visits per student per day, which appears rather impressive.

5.2 Evidence of field dependence (variable 2)

The term field dependence (variable 2) refers to the learning or cognitive style exhibited by learners who prefer to perceive and memorize information in collaboration with others or through working in teams with others (Anderson, 2001). Witkin (1973), a pioneer in the study of cognitive styles says, "Learning style refers to individual differences in how we perceive, think, solve problems and learn" (p. 76). Cassidy (2004) adds to this understanding when he asserts that learning style is "an individual's typical or habitual mode of problem solving, thinking, perceiving and remembering. [It is] the preferred way in which an individual approaches a task or learning situation" (pp. 420-421). Field dependent learners are those that Gardner (1983) calls interpersonal learners, and they tend to work well in teams. Thus, the analysis of data relating to this variable looked for students' comments in the GDCs streams, which reflected students' preference for sharing ideas, information or resources about their learning. Below, are examples of such posts in the GDCs, reported verbatim for variable 2. These are then followed by a similar analysis for all the other variables studied and then discussed in section 6.

For example, Anne expressed an interest in learning with her peers when she posted the following:

> I've just listened to Topic 5 lecture. Lots of information to read up on. The list of readings this week is enormous!! I'm not sure where to start. Not sure if I can get through it all. How is everyone else going?
> ~~XXYY~~ I enjoy reading your summaries - they are very good and informative. There are so many strategies for teaching - I wonder how we will go in applying it all in the real world? Back to the readings so I can post something more relevant next time.

Similarly, Joanna sought the assistance of her peers when she said:

> I am not 100% confident I have answered this correctly so I would love to get some feedback from others as to how they see the relationship.
> In your PLN discuss the relationship between Rich Tasks and Authentic Assessment and the NSW Quality Teaching Framework.
> Try to give examples of rich tasks that would fit with each of the three Dimensions of NSW QTF

Juliana's post is rich with many learner characteristics. It includes a combination of field dependence, interpersonal learning style, shared feedback, peer mentoring and anxiety:

> Hi all, I haven't finished all the readings, but here is a start...
> From what I have read so far, there seem to be two forms of constructivism;
> · Cognitive constructivism based on Piaget's work which focuses on an individual's isolated construction of understanding, where social interactions are only a facet of learning, and
> · Social constructivism, based on Vygotsky's theories that social interaction directly results in new understandings and knowledge.
> Australian classrooms today seem to favour social constructivism as an effective teaching and learning strategy that encourages and enhances concept modification.
> I hope this is right, my brain is reeling at the start of the semester, trying to understand new requirements and units.
> I know I would have loved the small groups, relevant tasks and inquiry methods involved in constructivism when I was at school rather than the teacher orientated direct transmission method I struggled under.
> Has anyone found, or thought of any major positives or negatives about the strategy

Additionally, Josephine said

> I have added my Critiques to my web page and sent you all an email. There are three critiques - under the home page. My webpage is plastered all over this circle site, so you shouldn't have trouble finding it!

Another student (Trudy) said

> I really like this you tube video on six thinking hats. Thought I would share in case anyone was unsure like myself. I wanted to know if you could just use a couple of hats in a lesson and not all six.
> http://www.dystalk.com/talks/25-de-bonos-thinking-hats_

Further interest in willingness and wishing to learn with others is illustrated by Clare who posted this:

> Week 2 Activity: I would like to share my experience of whole-class explanation and discussion. During my last prac I taught two maths lessons on Probability and Chance to a year 6 class. Most of the students were accustomed to the expectation of sitting and listening quietly when required. In the first lesson, it was easy to attract their attention in whole-class explanation, but I discovered that it is also very easy to lose their attention very quickly! I had to skip over some sections of my planned explanation (it was probably too long anyway) and move on to the more practical side of the lesson in order to maintain their interest. In the second lesson, I made things much more succinct, and kept a brisk pace. I did not engage the class in discussion, but we did play a whole-class game. This was very successful and fun (even for me!). The main things I learned from this experience were that (a) slow = boring = students switch off. (b) long wordy explanations from the teacher (with little student input) do little to encourage students to participate in learning. (c) explanation needs to be succinct and carefully worded. (d) explanation should facilitate student understanding rather than 'spoon feeding' information._

5.3 Assumption of control of learning (variable 3)

Frida took control of her learning, and was able to make links between lecture material discussed in her GDC and her teaching practice, and shared the experience with her peers in this post:

> I thought I'd share with you a rich learning task I created on my first prac. I had only been at the school for a week when I suggested to my supervising teacher an idea for a religion assessment which would incorporate English, music, and ICT. To my surprise she gave me the go-ahead to create the task and implement it. With little planning experience but a whole lot of enthusiasm and creativity, I set about creating a task for a year 7 class that would have them write a song about leadership, using our school's patron saints as inspiration. They would create and record the song using an iPod with the Garage Band app. Here is a breakdown of the different KLA's and the outcomes for each.
>
> Religion: Research a saint and identify the traits you could use to improve your leadership. Explore the concept of what a good leader is. ……
>
> This task was designed to be completed by groups of 6, of mixed ability. Each person was designated a role that suited their particular strength.
>
> It was a HUGE task to undertake for a first year prac, but I did receive plenty of support from the supervising teacher who helped me align the outcomes with the Australian Curriculum.
>
> Overall it was a huge success, albeit a little rushed, but well received by both students, parents and the teaching staff. The finish product was 4 songs that remain as a legacy of that grade.
>
> After listening to the week 4 lecture tonight I think this task meets many of the criteria of a rich learning task, even if I fluked it!!

Cecilia also demonstrated a locus of control on her learning with this post:

> Our discussion topic for this week:
>
> 1. Discuss differences and similarities between group work and cooperative learning work with a view to planning cooperative learning activities.
>
> Here are some of my thoughts:)
>
> Cooperative learning promotes positive interdependence among the students as well as individual accountability as all the students have to work together to achieve the goal. Because they are working together, cooperative learning promotes equal participation, team spirit and teamwork.
>
> Group work, unless taught cooperative learning skills, it promotes individual gain amongst the students and requires minimal participation from lazy students as they can rely on others to come up with the answer. Students in group work can be distracted and disengaged as there isn't a 'role' for them.
>
> "Cooperative learning requires each students to be responsible for a specific part of the teams task and the team only succeeds if everyone completes their contribution" (Lecture 3). In group work they can copy from other students and not necessarily contribute to the learning process.

5.4 Learning styles demonstrated (variable 4)

Cynthia, an interpersonal learner, interacted effectively with her GDC with this post:

> Hi all, Here are some similarities and differences between CL and group work. Feel free to add.
> Similarities
> * Provides opportunities for students to work together to achieve a common goal whilst reinforcing learning and providing social opportunities for students to develop deep knowledge.
> * They give opportunities to 'acquire skills, not just learn about them' (Kagan, 1994, p.2). Having said that, social skills often need development and teambuilding and established roles as suggested by Kagan are important parts of CL strategies.
> * Students can develop social skill, an integral part of modern life.
> Differences
> * If heterogeneous teams are formed, peer tutoring is maximised and the acquisition of new material becomes easier (Kagan, 1994, p.1)
> * In CL students learn to work together as a team, not as individuals. Resentments sometimes form in group work situations as there can be students achieving less than others or sitting back.

Loretta, another interpersonal learner, demonstrated her preference for this learning style in this post in the GDC:

> Thanks for sharing, what a great overview of a effective teaching style, one which we need to employ in the classroom for particular topics.
> I also think he would make a great teacher....

5.5 Evidence of self-regulated learning and metacogntion (variable 5)

The following posting in the GDC by Anita, appears to demonstrate several of Anderson (2001) model's characteristics including self-regulated learning and metacognition, (variable 5) as well as ambiguity tolerance, and anxiety (variable 6) when she says:

> Hi Group 4, how is everyone going in their test preparations? I personally dislike them intensely and am always left wondering if I could have done better….and of course, I always can! Ah well! (There should be a sigh icon I can insert)
> As to the week's activity……
> Here's my attempted summary of six questions (open and rhetorical?) applying Bloom's Cognitive Taxonomy.
> Rhetorical and open ended questions not only orientate students to the relevant subject matter, they offer opportunities for broader, more personal responses by generating quality discussion and investigation (Wilson, Wing & Lesley, 2003, p. 26).
> 1. Remember/ Tuning in /Factual knowledge; What do you know about…..?
> 2. Understand/ Finding out/ Conceptual knowledge; What are you asked to do here?
> 3. Apply /Sorting out /Procedural knowledge; How will you organise this information? (GO)
> 4. Analyse/ Going further /Meta-cognitive knowledge; What would you like to learn more about? Why?
> 5. Evaluate/ Reflection/Make judgments; What would you do differently next time? Why?
> 6. Create/Action/Re-organise; What have you learnt that you can now use in your everyday life?
> Questions adapted from 'Using Guided Inquiry Questions' , Wilson, Wing & Lesley 2003, p. 27.
> All the strategies in the readings seem to parallel each other in many ways, with a focus on process to enhance learning. I used Bloom because his scaffold provided a good platform for constructive questioning, as well as providing opportunities for using De Bono's Hats as a discussion format. When perceived and assessed under the guidelines of Howard's multiple intelligences, inclusive quality teaching and learning is the result.

Tricia appears to have taken responsibility for her learning and shared what she thought about her thinking (metacognition – variable 5) about her learning, to post this in the GDC stream.

> I believe constructivism is when students build on their own knowledge through their previous experiences and mistakes. Students are able to build on from their prior knowledge. In order for constructivism to work, instruction should be organised so students are able to grasp the idea easily and teachers should provide experiences and contexts that make students willing and able to learn. In a constructivist classroom, students are actively engaged in creating own knowledge, connect with new schema, are self motivated, self-conscious, are able to gain insight into their own beliefs, reconcile discrepancies, ask questions and gain insight on their own weaknesses.

Kirelli thought deeply about the resource she had discovered and shared her thinking of what she thought (variable 5) with her GDC:

> I love this quote from the 'Charter for the Australian Teaching Profession': "We inspire students to discover the joy of learning, drawing them into a world of knowledge, ideas and creativity. Our ambition for all is a lifelong engagement with learning". OH YEAH WANT TO BE AN ACTIVE PART OF THAT PROCESS!_

Another example of metacognitive engagement (variable 5) with learning comes from Gisella who said:

> Hello all, here's my summary of The NSW Quality Teaching Framework relationship with rich learning and authentic assessment. They all seem to roll around together, one demanding and supporting the other, neither viable on their own. Another educational cycle within a cycle! No wonder I feel dizzy occasionally.
>
> I put in the references because after a few years of mandatory referencing, I'm almost incapable of not referencing! It's almost the same feeling as trying to drive without a seatbelt, slightly uncomfortable! (My Mum did laugh when I signed her last letter with my name and added retrieved from after).
>
> The NSW Quality Teaching Framework promotes pedagogy and learning based on intellectual quality that provides significance to the student in quality learning environments (Department of Education and Training, 2003, p. 15).
>
> Quality pedagogy demands rich learning tasks that are related to others' learning whilst remaining relevant to the learner and responsive to their individual needs (McLeod, Reynolds, and Weckert, 2001, p.2). It requires planning that provides for and makes evident cross curriculum relationships that utilise the 'big picture' issue and purposeful inquiry as a context for developing and enhancing text, visual, computer, social and political literacies ' across the (McLeod, et al, 2001, p.4).
>
> Quality pedagogy also requires authentic assessment as part of the teaching learning cycle, usually involving self- directed actions from the student that 'produce, not reproduce knowledge' (McLeod et al, , 2001, p. 5), utilise complex thinking skills and cooperative learning, with a reflective component on individual learning progress (McLeod et al, 2001, p. 5).

5.6 Ambiguity tolerance, anxiety and motivation (variable 6)

Here are some examples which appear to illustrate some of the anxiety students experienced while learning with GDCs technology, as well as some ambiguity tolerance:

> [Nadia]-I just had a crack at the quiz... I was typing away in a word document, then looked back at the clock every now and then to keep track. The minutes just disappeared! I cut and pasted inside the last ten seconds... hope it went through, because I could not review it! Good luck all....
>
> ====
>
> [Oriana]-I can't really remember what I did. I was in a haze from being on prac and trying to get wk 3 work done. I have no clue if what I put down was educated thoughts or a lesson plan for my class.... I just hope I haven't kissed away 20% :/_
>
> ===
>
> [Nola]-Hi ~~XXXX~~ I'm slowly getting through the readings and beginning to think this 'circle stuff' might actually work!_
>
> ===
>
> [Terri]-Hi all
>
> so sorry about the delay in my participation in this group.
>
> Could someone just confirm for me that I have done this correctly
>
> I am a little nervous and just want to make sure before I do anything else.
>
> Thanks and sorry again for my late appearance.

Terrence was motivated enough, (variable 6) to go looking for pedagogical content that helped to inform peers in his PLN using the GDC stream with this posting*:*

> Hi all. This is my (late) contribution to the discussion about constructivist learning and teaching.
>
> I think that Roy Killen (in Effective Teaching Strategies: Lessons from Research and Practice - Chapter 1) puts it well when he says that "the term 'constructivism' has come to mean many different things to different people" (p.7). While constructivism may be approached cognitively and/or socially, 'it is essential to place the learner at the centre of your teaching endeavours' (p.8) in order to ensure that 'learners are provided the opportunity to construct their own sense of what is being learned' (p.7

Paulina and Derella demonstrated ambiguity tolerance and anxiety (variable 6) with these posts:

> [Paulina]-'half a page summary of teacher instruction for a whole class discussion on a children's book in a constructivist classroom'
>
> Does anyone know how in depth the instructions have to be?
>
> Do we try to cover content instruction, or a more general classroom management type instruction (listening skills etc)?
>
> ==
>
> [Derella]- Wait Im not sure if this is sharing to the right circle...could someone let me know if they are getting this?

Antonella appears to express anxiety (variable 6) when she posted this:

> Hi
> Circles and google docs is all new to me and I am hoping someone might be able to steer me in the right direction. Do we all add our thoughts regarding Topic 1 to the document set up by Lorraine in google docs? Is circles just used to post messages such as this? Sorry with the question but I am just starting to familiarize myself with this unit and finding my way around circles. I hope my understanding is correct.

Debra's ambiguity tolerance, anxiety and motivation (variable 6) could be inferred from this post:

> I've just listened to Topic 5 lecture. Lots of information to read up on. The list of readings this week is enormous!! I'm not sure where to start. Not sure if I can get through it all. How is everyone else going?
> Lyn- I enjoy reading your summaries - they are very good and informative. There are so many strategies for teaching - I wonder how we will go in applying it all in the real world? Back to the readings so I can post something more relevant next time.

5.7 Expressions of satisfaction/likes/happiness or dissatisfaction/dislikes about the learning experiences (variable 7)

Evidence of satisfaction and liking of the use of GDC is very well illustrated in this post in which Brunella said:

> Yes, you are right Charles and thank you for the alternative. It is so much more user friendly!_

Clarence liked the post by a peer in the GDC and considered it stimulating for group discussion with this post:

> This was an interesting look at Direct Instruction (DI)which illustrated how DI could also promotes active learning and scaffolding (via the teacher's questions).
> Certainly, a good stimulus for discussion from the group.

Rosanna shared her liking of this learning design with this praise of the lecture content discussed in the GDC stream:

> Hello Group 3. This weeks lecture and topic, co-operative learning, was one that I found very interesting. I can definitely see the vast benefits of this strategy as it involves and engages students optimally by providing intrinsic motivation. As each student is accountable unto his peers, it can create cameraderie and suport between classmates. This is definitely a strategy that i will employ, especially with tough concepts as students will be able to draw knowledge from each other through planned activities and guided scaffolding.

Angela really liked the opportunity this learning design created for her to access Web-based resources which supported her learning and she was able to share them with her PLN in the GDC, as shown by this post:

> Hi Everyone
> I found these two clips on YouTube that explain direct instruction. It really helped with my understanding so I thought I would share it with you

Serina, Jo and Peter expressed their liking of the use of this learning technology with these posts:

> [Serina]-Hi ~~XXYY~~
> finally got around to watching the video you put up about direct instruction . really enjoyed it thanks
> ==
> [Jo]-This sounds great ~~XXYY~~ concise yet understandable. Thanks for the thoughts, they are much appreciated. Sometimes ideas just roll round and round in my head and it helps so much to have someone else's clarity and summarising to straighten the kinks out.
> ====
> [Peter]-Found a very good explanation of constructivism on Youtube. Hope you can all open the link.
> Use a Learning Theory: Constructivism_

Katerina really liked this resource to which she was given a link by her peers in the GDC:

> I really enjoyed that video. I would be very happy if my classroom had this feel and look. It shows all students being engaged and excited about learning. They are learning through doing and discussing with peers. What a great video... all classrooms should look like this!

Kelly appear to have liked the summaries in her GDC and was grateful that others were participating and wanted more, as illustrated in this post in the GDC stream.

> Thanks for the thumbs up on the summaries, often I can't tell if they make sense because everything rolls around in my poor brain.LOL
> I am so grateful you are on here ~~XXYY~~, I wonder if the rest of our group can see our posts, or do we have a 2 man/woman group now? Would love more input, even though we seem to be doing a good job! LOL again.

5.8 Statements in the GDC streams about how the use of GDCs social media technologies scaffolds and supports/prompts their learning (variable 8)

Marisa comments on the abundance of supportive resources accessible via the use of GDCs when she says:

> There are heaps of resources for classroom activities that are discussed in this weeks lecture on Pinterest. Here are some I quickly came across. I love the idea of reinforcing in little children that everyone is smart in their own way, I love the wall chart and stars idea

Following this comment Marisa then posted in the GDC, resources from Pinterest, so that her peers could also use them to support their learning (variable 8).

In expressing how the use of GDCs supported her learning (variable 8) Tina said:

> I found this week's lecture and topic very useful. I personally think that rich tasks and authentic assessment are interrelated because when you plan engaging lessons, your assessment will be reflective of what students can achieve. There can be a tendency to make assessments haphazardous though, because there is not always text based evidence. Rather, the teacher is required to be involved in the student learning through observation, notes and assessing artifacts etc. Inquiry based teaching will be a very good "deep learning" experience as students have to really use higher order thinking through questioning and scaffolding. When learning is meanngful and ties in with students personal experiences, the content becomes significant to the child.

Timothy was keen to share his feeling of support when he came across a helpful Video clip which he shared in the GDC, saying it was "a great idea".

> Hi Guys, I'm doing all my catchup now for this topic (did EDLT320 last few days), while watching the week 1 videos about the 5E's model, I found this video with a great idea for group discussion in terms of making the task more fluent

Elizabeth shared her having improved her understanding of whole class explanation through this mode of learning in this post:

> In regards to the requirements for Week 2 - last year in my prac I actually did a lot of whole class explanation and a few sessions with whole class discussion, however it was never as well thought out as it should be. I didn't realise there were so many components to an effective whole class discussion and I think now that I know these principles I can hold more effective discussions in the future and give much better explanations. I think it was a combination of not knowing how to apply my theory to practice and not picking up on the cues from the students who didn't understand that made my explanations and discussions less effective. My next prac is in ES1 so I'm not sure how that will go with their fresh to school minds but we will see! What's everyone elses experiences with whole class discussions and explanations.

5.9 Evidence of response to feedback from the lecturer and peer mentoring (variable 9)

An example of peer mentoring is found in this deposit in this GDC by Andrew who said:

> Hi +~~XXXXXX~~how're you?
> Here are some interesting insights on Constructivism.
> Bruner - Constructivism in Education_

This posting by Tiyana was in response to the lecturer's feedback (variable 9) and also demonstrates her role in peer mentoring (variable 9).

> Hi all, I've been trying to summarise the instructions necessary for implementing a whole class discussion and have come up with;
> Inform class of lesson format and expectations
> Prior to discussion remind students of discussion rules
> Retain focus through probing and directing questioning
> Keep instructions simple
> Ensure discussion is inclusive
> Structure is vital to avoid unproductive outcomes and mayhem.
> The research involved made the whole process seem relatively simple if certain structures were followed, however I can imagine just how difficult it must be to encourage some children to participate. Like most activities involving diverse groups, I imagine that it takes time to build the supportive environment necessary for trust and confidence to blossom.

In responding to the lecturer's prompts (variable 9) in the GDC, Pamela also provided constructive peer mentoring (variable 9) with this post:

> I believe constructivism is when students build on their own knowledge through their previous experiences and mistakes. Students are able to build on from their prior knowledge. In order for constructivism to work, instruction should be organised so students are able to grasp the idea easily and teachers should provide experiences and contexts that make students willing and able to learn. In a constructivist classroom, students are actively engaged in creating own knowledge, connect with new schema, are self motivated, self-conscious, are able to gain insight into their own beliefs, reconcile discrepancies, ask questions and gain insight on their own weaknesses.

Natalia agreed and supported her peers with the following advice:

> I agree ~~XXXX~~,
> I like that with Co-operative Learning, there are no free rides so to speak, in that everyone has role to perform within the group. The reward for this is a more engaged learner and socially the benefits are huge. I can see CL being a great tool in my tool kit as a teacher, but I think it's important that its done right, which is what I have taken away from this weeks learning.

Veronica's feedback was also peer mentoring:

> I can also see many benefits in this strategy but see there is a big opportunity for it to lead to bullying and harassment should it not be supervised and structured correctly. Placing a student in a position which makes them accountable to the peers can be one which would result in negative interactions.
> Again with that said a teacher should consider this as a possible outcome when structuring and hopefully I won't encounter it while employing the strategy.

5.10 Overall analysis of how the use of GDCs social media supports learning, teaching and assessment, and academic achievement (variable 10)

Evidence of high quality learning is reflected in Laura's post saying:

> Rich tasks are those which have relevance to the leaner and are responsive to the learner's needs. In addition rich learning tasks are integrated with learning across several key learning areas. Rich tasks encourage productive pedagogies such as active citizenship, higher-order thinking, substantive conversation and problem-based curriculum. Authentic assessment refers to assessment which requires students to demonstrate their knowledge of specific content by displaying of a set of skills which they can apply to a real life situation. Authentic assessment is performance-based and requires students to exhibit the extent of their learning through a demonstration of mastery. It therefore requires the learner to take some form of action and the subsequent reflection of their progress.

Stephen, Cecily and Sarah really liked the opportunity to embed Youtube products into their GDC to support learning as they respectively said:

> [Stephen]-This is a great cooperative learning clip showing 'Jigsaw' being used in the classroom.
> [Cecily]-Thank you Melissa. Great video.
> [Sarah]-This is so good! And of course it looks so easy to implement, but i know the advanced planning required would have taken time and skill in knowing how the students learn etc. It is definitely something i would like to try :)

Tania showed mastery of the differences between cooperative learning and groupwork and thought the learning experience was great:

> I had the pleasure in my last prac of helping in a CCT unit, (creative, critical thinking).The unit was THE GOLD RUSH.Year 5.
> The students were placed in teams of their choosing, 3-4 members. This was to save arguments as they were a very clicky little class and the teacher said it was easier and produced better outcomes than mixing the class. They were given a sheet with 7 tasks and each member would choose one r more tasks to complete. Each task included ICT investigation, discussion with peers, design and reflection. The students were given time to complete their tasks, then teach the rest of their team. The team would then appoint a leader to teach the class. Each team was given different tasks so on completion the students taught the class. I was at first hesitant about this but the results were incredible. The students were quite competitive.
> The teams were also given a rubric so they knew what they should include for the best result in assessment.
> This experience was completely different to the group work I have witnessed. This had definite leaders, followers and students who sat back and did nothing. These students didn't loose out, in their opinion, as they still received the same marks.
> I have felt annoyed myself when I have completed group assignments and worked harder than other group members.
> I believe co-operative learning is a excellent way to increase engagement, the benefits and results I witnessed were outstanding.

Tiffany's post provided some evidence of good knowledge construction while using GDCs to learn:

> I like to see myself as a guide in the classroom. Guiding students in facilitated activities and discussions that will lead to a better understanding and an increase in knowledge for them. You can't teach them when they aren't ready. The key to constructivist teaching is that students construct their own knowledge, not the teacher imparting their own knowledge upon the students.

Peta demonstrated good academic outcome with this contribution:

> My understanding of constructivist learning is when teachers design their lesson so that the students can construct their knowledge using the existing knowledge they have developed from their own life experiences. Constructivist learning and teaching is to not provide the answers, rather ensure the students figure the answer out themselves, being free to make mistakes. As the only saying goes 'we learn from our mistakes'. Constructivist learning also provide opportunities for students to learn from each other, to investigate problems together and find or debate solutions together.

Greg shared his appreciation that this methodology had supported his learning and hoped that it would help his peers as well, with this post:

> Found a very good explanation of constructivism on Youtube. Hope you can all open the link.
> Use a Learning Theory: Constructivism_

Craig was given a Url in his GDC which he found inspiring and educational as in this post:

> This video is very inspiring and educational. Thank you Paul for sharing what it is like to live with CP and the challenges you face in life. It is nice to know you have a good support network. Also I like your quote for future educators to let CP kids be kids and for future educators not to treat them any differently.
> Thank you for sharing.

Glenda was very emphatic in her assertion that the use of GDCs was very supportive in her learning and overall academic performance, and she really liked learning using GDCs. She was keen to see other students get on board when she posted this:

> What a wonderfully busy global classroom. It is so hard to describe the excitement, engagement and curiosity that can be found in learning such as this. How do we bring others on board? Posts like this help share what teachers and students can do when they are connected! Great work.

6. Discussion

The 42,114 posts in the stream of the master GDC – EDLT219-2014-1, comprising all the data such as illustrated in Figure 3 (PLNCK4) and Figure 4 (PLNCK1), contain massive amounts of data about students' experiential learning when using GDCs. As said earlier, the results presented above were analyzed with specific reference to the ten variables derived from Anderson's (2001) model of how to analyze students' interactions when they are engaged in Web-based learning, which was presented above in Figure 1. It is clear from the posts in the GDCs streams that many of them could be used to illustrate students' characteristics under several of the variables in the model. It is also possible that the same data bit could be used as evidence for more than one variable. In the analysis presented above, efforts were made to allocate the data to the variable they most accurately represent. Where the same data post is used for more than one variable that is also indicated. As this approach is rather subjective, it is possible that the

reader would associate a particular data bit with a different variable, and that is understandable. Nevertheless, the results appear to provide a very good understanding of some of the attitudes, characteristics, knowledge, scaffolding, feedback, likes, and academic performance that the students studied, had experienced. In an area that has not attracted much research, these results potentially represent ground-breaking research into students' experiences when they are engaged in learning using Web-based, cutting-edge technologies of the 21st century.

The results suggest that on the whole the students were positively inclined towards working in digital PLNs using GDCs. As this was a new technology for them, with most of them creating a GDC for the first time, it is not surprising that there was evidence of anxiety (variable 6). However, there was also evidence of ambiguity tolerance, and the will or motivation (variable 6), to have a go, regardless of the anxiety.

The increase in participation rates (variable 1) ranging between 180% and 470% noted in the GDC of PLNCK4 and in the GDC of PLNCK1, respectively, is certainly an encouraging insight into the potential impact of using GDCs social media technologies to support learning, teaching and assessment. What's more, the posts in the streams of the GDCs indicated high levels of interactions and field dependence (variable 2 and 4) among PLNs as the students demonstrated high levels of engagement, exploration, explanation, elaboration, and evaluation of the contents in the GDCs streams. According to Bruner (1966) and Bybee et al. (2006), when students participate in learning using these 5Es, their potential to maximize learning (variable 10), is enhanced. Furthermore, the conversations shared in the GDCs demonstrate a high level of cooperative learning (variable 2). Such learning, according to many luminaries in this field, including Slavin (1988), Artz and Newman (1990), Johnson and Johnson (1991, 1994), Cohen (1994), Kagan (1994), and Sherman (2001), promotes higher levels of academic performance (variable 10), than individualistic or competitive learning.

The evidence in the GDCs streams such as that posted by Anne, Joanna, Juliana, Josephine, Trudy and Clare suggests that when students learnt through PLNs driven by GDCs, they demonstrated positive field dependence (variable 2) consistent with Witkin (1973) and Gardner's (1983) interpersonal learners (variable 4). Contributions to the GDC streams such as the YouTube video discovered by Trudy who then shared the Url with her GDC clearly demonstrate the sharing spirit (variable 2), and interpersonal nature (variable 4), that was evident in this GDC.

It is not always the case that 2nd year Bachelor of Education students assume control of their learning (variable 3). It was, therefore, very encouraging to see posts in the GDC streams such one by Frida and another by Cecilia, which were indicative of these students' inclination towards "internal locus of control" (variable 3) (Anderson, 2001, p.51).

The most prevalent learning style demonstrated by students learning using GDCs was the interpersonal learning style (variable 4). This was well illustrated, for instance, by Cynthia and Loretta's posts. High levels of self-regulated learning (variable 5) were demonstrated by many students as represented by Anita, Tricia, Kirelli and Gisella.

As said previously, some students demonstrated anxiety (variable 6) as they started to create and to engage with GDCs for their first time. But there was also evidence that they tolerated ambiguity (variable 6) as they sought clarification from their peers (variable 10). These characteristics are very clear from the posting in the GDCs by Nadia, Oriana, Nola, Terri, Terrence, Paulina Derella, Antonella and Debra. However, what's more, Terrence appears to have been motivated enough (variable 6) to go looking for new pedagogical content which he then shared with his GDC (variable 2).

The results, in the main, demonstrate an overwhelming level of satisfaction (variable 7) across all GDCs. Many students, including Brunella, Clarence, Rosanna, Angela, Serina, Jo, Peter, Katerina and Kelly, expressed satisfaction with the GDCs learning experience, and some actually stated that they liked the experience.

It was very encouraging to see comments such as those posted in the GDCs by Marisa, Tina, Timothy, and Elizabeth, alerting their peers to the resources and pedagogical content that was available and which they could share via GDCs to support and scaffold their learning (variable 8). Also very encouraging were comments in the GDCs that reflected peer mentoring (variable 9) among students and response to instruction or feedback provided by the lecturer (variable 9). These examples include the posts by Andrew, Tiyana, Pamela, Natalia, and Veronica.

A careful review of the posts in the streams across the GDCs shows that many students, including Laura, Stephen, Cecily, Sarah, Tania,Tiffany, Peta, Greg, Craig and Glenda, made comments which demonstrated that overall, the use of GDCs social media technologies supported their knowledge construction and academic performance (variable 10). Students shared posts that reflected mastery of the pedagogical content knowledge (variable 10) that they had discussed in the GDCs streams.

7. Conclusion

Whereas the impressive participation rates discussed above don't tell much about the nature or quality of learning that occurred while students were studying using the GDCs, an analysis of what the students actually said and its pedagogical content or quality, sheds some light on how the use of GDCs social media technologies supported learning, teaching and assessment for these students. The posts, such as those by Laura, Stephen, Cecily, Tania, Tiffany and Peta, (illustrated in 5.10 above) showed that these students had learnt well the concepts that were being taught. The comments such as those by Laura and Peta demonstrated that these students had gained deep learning (Entwistle, 2000; Johnston, 2014) rather than surface learning (Lublin, 2003). Peter (in variable 7) and particularly Glenda (in variable 10) very categorically shared their appreciation of this methodology of learning using GDCs technologies.

The evidence contained in the GDCs streams appears to be consistent with Sherman's (2001) proposition cited earlier that the use of computer supported collaborative learning environments has potential to facilitate the process of "intersubjectivity in which learners communicate in a reciprocal process of discourse and engage each other's construction of credible reality" (p. 122). The use of GDCs social media technologies appears to have created opportunities for students in EDLT219-2014-1 to learn experientially as suggested by Johnson and Johnson (1994). As noted earlier, experiential learning can be a very effective way for cognitive processing because in involves learners in a cyclical process involving taking action, experiencing consequence and re-organising information so as to a develop deeper understanding of pedagogical content knowledge.

It would appear that the conversations and the resources that the students shared in the GDCs streams were consistent with Slavin's (1996) social cohesion dimensions because students helped their peers to access new resources and to share information "because they cared about one another and wanted one another to succeed" (p. 46).

Thus, the findings appear to be in concert with Howell's (2012) proposition that contrary to traditional thinking, social media are useful, not just for social conversation, but also as a means that facilitates active learning. No doubt, 21st century human activities outside the classroom and lecture theater, particularly among Marc Prensky's (2001, p. 3) "Digital Natives", or Don Tapscott's (1998, p. 15) "Net Generation", are highly penetrated by, and to a high degree dependent upon, the use of social media technologies. It therefore makes a lot of pedagogical sense for pedagogues to use these technologies to support learning, teaching and assessment in schooling contexts, particularly in higher education. Teaching using these technologies is not only consistent with the constructivist philosophy of student-centric active learning (Piaget, 1923; Vygotsky, 1929), and participatory learning (Bruner, 1966), but also with authentic pedagogy (Flewelling & Higginson, 2002; Gulikers, Bastiaens, & Kirschner, 2004; Wiggins, 1990). The more we can create learning, teaching and assessment environments that are similar to the conditions beyond school, college and university where our students live, work and study, the more student-centric, more student-participatory, and more authentic our pedagogical practices will become.

Indubitably, much further research is needed to shed more light on the potential of social media technologies to support pedagogical practice. However, such research should find a lot of encouragement in the experiential feedback from students such as Glenda, (variable 5.10) who, as shown in the data for variable 5.10, demonstrated superlative admiration for learning using these digitally connected technologies when, to reiterate her own words, she said:

> *What a wonderfully busy classroom. It is hard to describe the excitement, engagement and curiosity that can be found in learning such as this. Posts like this help to share what teachers and students can do when they are connected! Great work.*

It would be equally hard to express the potential pedagogical value of social media technologies in a better way. For it is the humble opinion of this researcher, that if social media technologies could be used to effectively support pedagogical practice by a tiny fraction of how they have impacted human interactions in other walks of life (such as commerce, politics and religion), that fraction, - call it 'a little step', - would represent a 'gigantic leap' in the advancement of pedagogical practice in the 21st century.

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