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Structural Model of Team-Based Learning using Web 2.0 Collaborative Software

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Abstract

This study examines team-based learning using Web 2.0 collaborative software. Based on grounded theory approach, this study analyzes students' feedbacks regarding team collaborative learning under Web 2.0 platform. Data analysis yields a structural model of team-based learning using Web 2.0 collaborative software. That is, from the data analysis, this study drew inferences that Web 2.0 collaborative learning environment unfolds diverse communication media in support of media synchronicity. Subsequently, media synchronicity facilitates group awareness. For team-based learning using Web 2.0 collaborative software, this study reveals that three factors, namely, group awareness, learner autonomy and collective intelligence support team-based learning.

Keywords

Team-Based Learning, Web 2.0 Collaborative Software, Grounded Theory

1. Introduction

Web 2.0 refers to web tools and services that encourage visitors to share, collaborate, and edit information, promoting a more distributed form of authority that blurs the boundaries between site creator and visitor (Oberhelman, 2007). In essence, Web 2.0 fosters active participation among audiences rather than distributing information to passive audiences. By promoting active participation and interaction among audiences, Web 2.0 supports collaborative learning (Rollet et al., 2007). It was also argued that Web 2.0 is well suited to active and meaningful learning and collaborative knowledge building (Mejias, 2006).

Additionally, with the growth of social networking and use of Web 2.0 tools and services among a new generation of students, there is a paradigm shift from Learning Content Management Systems to more user-centered approach in education (Craig, 2007). That is, students collaborate, develop and share content using various tools and resources, and learn together (Downes, 2005).

Despite the advantages of Web 2.0 technology, technology alone does not deliver educational success. Technology only becomes valuable in education if learners and teachers can do something useful with it (Virkus, 2008). Thus, researchers have been focusing more on how to

incorporate Web 2.0 into the learning process and how to apply Web 2.0 concepts to create new learning experiences (Chatti et al., 2007).
There are a few studies about Web 2.0 in learning but there has been no study proposing a comprehensive structural model that demonstrates the impact of Web 2.0 technology on collaborative learning. Thus, this study collected learners' feedbacks regarding their experiences of using Web 2.0 tool for group collaboration. Then, we employed grounded theory to analyze these qualitative data to propose a comprehensive structural model of team-based learning facilitated by Web 2.0 technology. This model provides a better understanding of how to effectively incorporate Web 2.0 into learning process for creating compelling learning experience.

2. Research Methodology

2.1 Data Collection

This study collected qualitative data from two different research sites that participated in group projects. The participants collaborated in groups by using Web 2.0 collaborative software to prepare reports for their group projects. The software contained two main features: document sharing and group discussion. For document sharing feature, this Web 2.0 collaborative software included tool similar to the traditional word processing software (e.g., Microsoft Word) that allowed participants to prepare and save their reports online. Then, the reports were shared with every team member. That is, team members would logon to the system and help edit the reports in anytime and from anywhere.
For group discussion feature, participants would setup an online group discussion page for their group in the system. Then, any group member would either reply to a message posted by any other group members or post a message or question of his or her own.
In this study, it was mandatory for every group to prepare and save their reports using the document sharing feature. Additionally, every group was required to setup the discussion page. However, each group was not limited to communicate only through the group discussion feature. Each group was allowed to meet face-to-face, to use telephone, or to communicate using other tools (e.g., email, video conference, instant messaging) available in any other resources. Upon project completion, the written feedbacks from the team members were collected for data analysis.

2.2 Data Analysis: The Grounded Theory

To analyze students' feedback, this study employed the grounded theory paradigm postulated by Strauss and Corbin (1990). The major reasons to adopt the grounded theory approach are (1) this research serves to conduct an in-depth study on using Web 2.0 collaboration tool to support team-based learning and (2) the grounded theory paradigm is appropriate for the study with a broad research question (Niederman, 2009). Based on the grounded theory paradigm, this study applied open coding, axial coding, and selective coding procedures.
To reduce biases in the coding procedures, the researchers began with a broad research topic in mind – team-based learning using Web 2.0 technology in higher education. Next, before venturing into literature reviews, the researchers started out by reading the students' feedbacks together to identify incidents and define subcategories and their respective categories from the incidents. Essentially, literature reviews were conducted after the discovery of incidents and

subcategories/categories. Then, the researchers narrowed down the research topic. This practice was consistent with the notion of theoretical sensitivity highlighted by Urquhart (2001), postulating that researchers should enter the fields without preconceived views to prevent the researchers from imposing predetermined categories during the coding procedures.

During the open coding procedure, narratives or sentences from students' feedbacks were analyzed line by line by the researchers in a face-to-face manner. Differences in coding arose among the researchers and this was resolved by finding a common ground.

The researchers kept a "code book" using a spreadsheet, which outlined the specific transcript number, narrative or the line number of a sentence, and incident. More than 300 incidents were defined. The incidents were then classified into concepts or subcategories. Next, the researchers proceeded to axial coding to link the subcategories found from the open coding into their respective categories. This study adapted the two-step process employed in one previous study (Sarker et al., 2001) to connect the subcategories to their respective categories. In the first step of the adapted approach, the subcategories defined from the open coding were related to each other. Then, in the second step, after the potential subcategories/category relations had been identified, literature review was employed to refine and verify these potential subcategories/category relations.

Finally, the objective of selective coding is to explicate a story by identifying "core categories" and linking these "core categories" to each other. During the selective coding, the subcategories/category relations defined in the axial coding were linked to their respective "core categories" or components of the structural model of team-based learning using Web 2.0 collaborative software (see Figure 1). This study employed several theoretical frameworks as the mechanism for identifying the "core categories" and for explicating a story line that was grounded in the collected data. The next section discusses the emerging "core categories" or components of the structural model together with the chosen theoretical frameworks that identify these "core categories".

3. Discussion

3.1 Communication Media

3.1.1 Heterogeneous Communication Media

Multiple communication media, namely asynchronous and synchronous media, were available for team members to use in their team collaboration. Asynchronous media included email, group discussion page, etc. Synchronous media consisted of video conferencing, instant messaging, face-to-face communication, etc. Team members commented on the presence of heterogeneous communication media they used in their team collaboration.

… Our team typically communicated either via the telephone or email to handle any issues that arose while completing a portion of the assignment. On a few occasions we set up teleconferences to discuss or prepare for assignments or presentations. A few team members usually would meet up in the computer lab to make last minutes adjustments…

3.1.2 Communication Media Selection

The heterogeneous communication media enabled team members to communicate using a specific type of media given the circumstances. Team members could decide which type of media to use based on the task on hand.

…Face-to-face communication was used for assigning tasks and discussing about research project and presentations...E-mails were sent for reminding about due dates and tasks of each member…

The above comment suggested that synchronous media were used to discuss more complex issues whereas asynchronous media were adopted for simple issues. This comment was consistent with Media Richness Theory (Daft and Lengel, 1984), which postulated that team members employed leaner media (e.g., email, group discussion page, document sharing feature) for less ambivalent information exchange and richer media (e.g., video conferencing, face-to-face communication) for more ambivalent information exchange (Walter 1992; Walther, 1995).

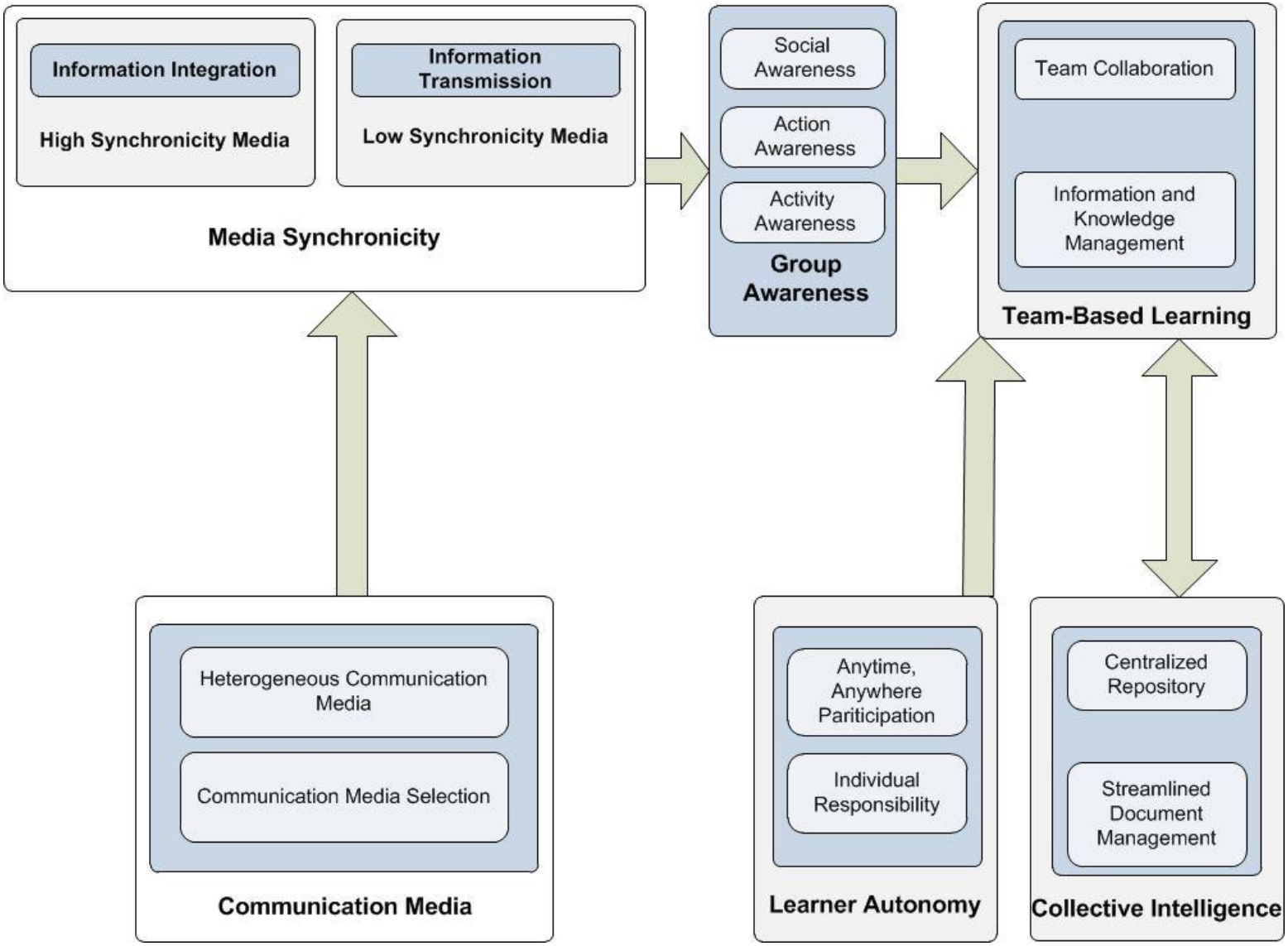

Figure 1: Structural Model of Team-based Learning using Web 2.0 Collaborative Software

3.2 Media Synchronicity

Synchronicity denotes a condition where individuals work simultaneously with a shared focus and understanding; however, using electronic media synchronously is necessary but insufficient for synchronicity (Dennis, Fuller and Valacich, 2008). Media synchronicity indicates how well a communication medium enables individuals to achieve synchronicity (Dennis, Fuller and Valacich, 2008).

3.2.1 High Synchronicity Media

High synchronicity media refers to the media that have high capability of achieving shared understanding and shared focus among team members (Dennis, Fuller and Valacich, 2008). High synchronicity media embody low parallelism, low rehearsability, low reprocessability, but high immediacy of feedback and high shared focus (Munzer and Borg, 2008). In this regard, high synchronicity media (e.g., face-to-face communication) effectively establish mutual understanding and shared focus to sustain information integration (i.e., convergence) – a process that relates pieces of information to each other so as to draw conclusion from the patterns of relations (Munzer and Borg, 2008). A few students commented that Web 2.0 collaborative software could have incorporated features to emulate face-to-face communication for exchanging non-verbal cues.

…I would like to have Web-Cams used in the [Web 2.0 collaborative software]. It gives the opportunity for each member to get reactions from others members. Having a face-to-face conversation allows one to get a feel of what the other members are thinking and what their likes and dislikes are…

High synchronicity media (e.g., face-to-face communication, video conferencing) transmits rich verbal and non-verbal cues in support of high social presence, promoting mutual understanding and shared focus for information integration (Short, Williams and Christie, 1976; Dennis, Fuller and Valacich, 2008).

3.2.2 Low Synchronicity Media

Low synchronicity media (e.g., email, document sharing feature, group discussion page) has the following characteristics (Munzer and Borg, 2008): high parallelism that supports simultaneous information sharing by allowing team members make concurrent posts, high reprocessability and high rehearsability that enable team members edit their messages prior to posting, and low immediacy of feedback that does not demand immediate response but permits enough time for team members to compose a well-thought message before posting. Building on Media Synchronicity Theory (MST), low synchronicity media transmit information simultaneously, supporting effective information transmission and sharing (Dennis, Fuller and Valacich, 2008). In this study, team members recognized the advantages of using low synchronicity media, particularly, the document sharing feature.

...We tried to communicate with each other through the [Web 2.0 Collaborative Software] when we were doing our work. Sometimes we were doing our work at the same time so that we were able to see what all changes the other partners were doing at that time...

3.2.3 "Communication Media" Facilitates "Media Synchronicity"

In team-based learning under Web 2.0 collaborative learning environment, this study draws inferences that the availability of diverse communication media and the media selection capacity unfold the communication platform consisting of high and low synchronicity media. Alternatively, high and low synchronicity media are the outcome of open communication platform favoring the presence of heterogeneous media and the freedom of diverse media selection.

3.3 Group Awareness

Data analysis revealed that Web 2.0 collaborative software also served as a group awareness tool. Group awareness pertains to a notion that the efficiency of group activities relies on team members' awareness about the presence of other members, the commonly shared objects and the existing group processes (Gross, Stary and Totter, 2005). Given that, group awareness constitutes social awareness, action awareness, and activity awareness (Caroll et al., 2003).

3.3.1 Social Awareness

Social awareness concerns the changes in team members' presence that highlights the non-verbal communication, including the facial expression of team members (Gross, Starry and Totter, 2005). Team members had voiced the needs of realizing the presence of other members.

…The fact that we never met created some distance between us where people did not feel personally responsible because we were not communicating on a face-to-face basis…

High synchronicity media integrated in Web 2.0 collaborative software would help team members realize the other members' presence, create social awareness, and eventually support mutual understanding among the team members. Although low synchronicity media (e.g., group discussion page, email) transmit very little non-verbal cues, low synchronicity media would also promote social awareness by providing a channel for members to post "background information" (e.g., personal description, personal photo) to leave an impression.

3.3.2 Action Awareness

Action awareness is the information about what has happened to the commonly shared objects and who has modified the objects (Caroll et. al., 2003). Regarding action awareness, team members provided the following feedback:

…I think it would be interesting if the program color coded who had changed the document and where it was changed by that person…

For Web 2.0 collaborative software, low synchronicity media (i.e., document sharing feature) would foster action awareness by highlighting the changes made to a shared document and the person who made the changes. Additionally, low synchronicity media (e.g., group discussion page, email) would enable team members carefully edit and review their messages during team discussion related to the changes made to the shared document. Similarly, high synchronicity media would enhance action awareness by offering another communication channel for team members to attain mutual understanding about the changes made to the shared object.

3.3.3 Activity Awareness

Activity awareness provides information regarding the completion of group objectives so as to increase knowledge on the group's task performance (Kimmerle and Cress, 2008). Activity awareness helps team members realize the overall progress to share and distribute a common goal (Caroll et al., 2003; Endsley, 1995).

… [This Web 2.0 collaborative software] made a group project like this a lot easier in the sense that everyone in the group was able to view the documents to see how far we were in the projects…

…Another advantage of this software is the ability to track [changes]…The tracking feature was nice because it helped to ensure everyone had contributed…I think it keeps [team members] on their toes when they see that their team members have already submitted their parts and everyone can see their contribution. It prods them to contribute...

The above students' feedbacks inferred that low synchronicity media (e.g., document sharing feature, group discussion page) served as the activity awareness tool to track progress and team members' contributions. The ability of tracking changes and demonstrating team members' contributions exemplified the capacity of gathering information about the overall happenings in the collaborative environment (Kimmerle and Cress, 2008).

On the other hand, high synchronicity media would also foster activity awareness by enabling team members communicate instantaneously. This would promote better understanding about the other members' perceptions and feelings regarding the team progress, the shared plans, and the rationale behind a decision.

3.3.4 "Media Synchronicity" Facilitates "Group Awareness"

Group awareness signifies group activities' efficiency attained through information gathering of the other team members, of the occurrence of commonly used objects, and of the existing group processes (Gross, Starry and Totter, 2005). Based on the aforementioned analysis, we proposed that both high and low synchronicity media embedded in Web 2.0 collaborative software foster every aspect of group awareness (i.e., social awareness, action awareness, activity awareness) for effective team-based learning.

3.4 Team-Based Learning

In team-based learning, learning is the outcome of interaction among team members who exchange ideas and share experiences to attain group solutions (Shen, Hiltz and Bieber, 2006), bringing about knowledge construction (Michinov and Michinov, 2008). Thus, two major components of team-based learning include team collaboration and information and knowledge management.

3.4.1 Team Collaboration

Team-based learning encompassed team collaboration associated with the interaction among team members who exchanged ideas and shared experiences to reach group solutions (Shen, Hiltz and Bieber, 2006). Team members collaborated not only to exchange ideas but also to

"*support learning by providing social support and encouragement for individual efforts*" (Alavi, 1994, pg. 161). In this study, data analysis revealed that team collaboration occurred.

…Our team discussed everything from difficulties one might be having with research, time to work on the project, confusion of what to type, or even just not being able to make it to [meeting] and we all worked together helping everyone stay on track by responding with suggestions or words of encouragements...

…We discussed about the article to make sure that we agreed in the same way. We divided the responsibilities. We helped each other. We opened up for everyone opinions…

3.4.2 Information and Knowledge Management

Team members made sense of the information presented by other team members. Team members made efforts to review, edit, and verify other members' works and to piece things together so that all of the available information was integrated and organized to produce one cohesive flow, resulting in knowledge construction.

Additionally, Knowledge Management (KM) focuses on exposing individuals to potentially useful information and facilitating assimilation of information, building and managing knowledge stocks, and organizing access to and retrieval of content (Alavi and Leidner, 2001). In this study, knowledge creation, knowledge sharing, and information management took place.

…After the project was complete it was then checked to make sure that document flowed and was checked for grammatical errors…

…We posted documents and other articles in the system. I like the way which the system organizing our documents so we can view the documents by type and shared. Also, when I typed some mistakes, other members will correct them for me…

The aforementioned comment suggested that team members collaborated to organize and manage information for knowledge creation and sharing. Essentially, team collaborative activities produced emergent knowledge, which was the outcome of interaction among team members during the process of knowledge formation (Whipple, 1987).

3.4.3 "Group Awareness" Facilitates "Team-Based Learning"

Social awareness entails the presence of verbal and non-verbal cues to enhance social presence for personal communication (Caroll et al, 2003). This helps to build mutual understanding that strengthens team collaboration, thus promoting team-based learning. With mutual understanding, information integration can be performed effectively (Dennis, Fuller and Valacich, 2008), leading to effective information and knowledge management in favor of team-based learning.

Regarding action awareness, when team members recognize the changes occurred to a common object (e.g., shared document), team members can further organize the information with less confusion. The effective organization of information brings upon knowledge construction (Nonaka, 1994), fostering information and knowledge management for team-based learning.

Activity awareness supports information gathering about the common goal of a group, resulting in knowledge augmentation for team performance (Kimmerle and Cress, 2008). Activity awareness also makes team members aware of the events occurred (Caroll et al., 2003). When team members can identify what is going on in the collaborative environment, team members form a shared mental model to understand and support decision making (Yen et al., 2004). Given mutual understanding in decision making, conflicts can be avoided to enhance team collaboration (De Drue and Weingart, 2003) for team-based learning.

3.5 Collective Intelligence

Collective intelligence represents intelligence that is derived from the collaboration of many individuals (Gruber, 2008). Web 2.0 technology enables collective intelligence by supporting effective information sharing through user interactions (Wagner and Majchrzak, 2007).

3.5.1 Centralized Repository and Streamlined Document Management

In this study, team members appreciated the centralized repository (i.e., knowledge database) that streamlined document management.

…Not having to email large files within our group [not only] helped with controlling revisions, but also helped by giving everyone the ability to work on the document at once. While working on various documents, the software continuously saved any changes that had been made which helped because had my computer crashed the document would be saved on the [Web 2.0 collaborative] site and I wouldn't have to worry about working off a recovered document or having to start over because the work could not be recovered…

Centralized repository served to streamline document management by making the shared document easily accessible and by keeping only one version rather than multiple versions of the shared document. Thus, team members did not have to keep duplicate copies of the same document. Additionally, by streamlining document management, centralized repository effectively organized and shared documents to support efficient information browsing or searching (Chituc et al., 2009), foster information organization and aggregation (Ractham and Zhang, 2006) and finally promote knowledge creation and sharing (Nonaka, 1994). Hence, centralized repository engenders collective intelligence.

3.5.2 Reciprocity between "Collective Intelligence" and "Team-Based Learning"

In team-based learning, learning depends on the interaction among team members who exchange ideas and share experiences to achieve group solutions (Shen, Hiltz and Bieber, 2006), leading to knowledge construction (Michinov and Michinov, 2008). Facilitated by team collaboration and information and knowledge management, team-based learning promotes knowledge construction to produce collective intelligence (Gruber, 2008).

On the other hand, collective intelligence renders cognitive reflection to help team members construct meanings (Boulos, Maramba and Wheeler, 2006). By referencing the knowledge database (i.e., centralized repository), team members can recognize the existing knowledge and later initiate a concerted effort to derive new knowledge from it. Thus, collective intelligence also promotes team-based learning.

3.6 Learner Autonomy

3.6.1 Anytime – Anyplace Participation and Individual Responsibility

Due to anytime and anyplace participation capability of Web 2.0 collaborative software, team members enjoyed the freedom of choosing when and where they worked and how they wanted to perform their tasks on hand.

…[The Web 2.0 collaborative software] enabled me to work on my own time...I went and I did what I was supposed to, and in turn [other members] did their parts and then we edited it to make sure all were alright. It gave me a lot of freedom in my work, environment, time, etc., and because of that I was able to enjoy doing it much more…

Learner autonomy stems from learners' ability of taking responsibility for their own learning (Holec, 1980). In specific, learner autonomy relates to the amount of initiative and self-regulation that a learner will use to explore, plan and accomplish educational goals for determining the learning experiences (Moore, 1993). Referring to the above comment, team members were free to choose the time and place to learn, and therefore, they took individual responsibilities for their own learning. This produced learner autonomy (Murphy, 2008).
In this study, team members also emphasized the importance of individual responsibilities.

…I cannot stress how important it was to our group that we were all responsible for portions of the paper and completed our tasks in a timely fashion…

…Once our system was developed, we knew what sections of the report each team member was responsible for each week and also who was responsible for formatting and editing. All team members were required to complete each of their individual sections two nights before class…

3.6.2 "Learner Autonomy" Facilitates "Team-Based Learning"

In this study, virtually all teams were self-managed teams. Self-managed teams required team members taking responsibility for ensuring the quality of teamwork and distributing the management and/or leadership functions of the team (O'Connell, Doverspike and Cober, 2002). This infers that individual responsibilities enhance teamwork or team collaboration. Hence, we argued that, fostered by anytime-anywhere participation and individual responsibility, learner autonomy facilitates team collaboration for team-based learning.

4. Conclusion

This study analyzed students' feedback on using Web 2.0 collaborative software to collaborate in the students' team projects. From the data analysis based on the grounded theory approach, this study drew inferences and proposed the structural model of team-based learning using Web 2.0 collaborative software.
Web 2.0 collaborative learning environment unfolds diverse communication media in support of media synchronicity. Subsequently, media synchronicity facilitates group awareness. For team-based learning using Web 2.0 collaborative software, this study reveals that three factors, namely, group awareness, learner autonomy and collective intelligence support team-based learning.

The main research contribution of this study is the proposed comprehensive structural model of team-based learning facilitated by Web 2.0 collaborative software (see figure 1). This research suggests that, for team-based learning using Web 2.0 collaborative software, diverse communication media and freedom of communication media selection facilitate media synchronicity. Subsequently, media synchronicity promotes group awareness, supporting team-based learning. In particular, media synchronicity enables group awareness by allowing learners realize the presence of other learners, the changes made to a shared object, and the overall progress of team projects.

This research also posited a bilateral relationship between collective intelligence and team-based learning using Web 2.0 collaborative software. In Web 2.0 collaborative software, collective intelligence is another important feature that supports team-based learning. Collective intelligence enables learners referencing the existing knowledge database (i.e., centralized repository) followed by initiating a collaborative effort to derive new knowledge from the current knowledge. On the other hand, team-based learning engenders collective intelligence. That is, the knowledge created through the collaborative efforts of team-based learning renders collective intelligence.

The main research implication of this study is to test the proposed comprehensive structural model. For example, in team-based learning using Web 2.0 collaborative software, does media synchronicity support group awareness? Besides, the main practical implication of this study is the design practices for collaborative tools using Web 2.0 technology. For example, the collaborative tools should include (1) diverse communication media and allow learners to select the types of communication media to use according to the tasks on hand and (2) centralized repository and other functions for streamlining document management.

Finally, this research is not without limitation. It was conducted at only two different research sites. Although the research findings are warranted, it is necessary to test the framework in a setting with bigger population.

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