

Big Data and Knowledge Generation in Tertiary Education in the Philippines

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This exploratory study investigates the use of a computational knowledge engine (WolframAlpha) and social networking sites (Gmail, Yahoo and Facebook) by 200 students at De La Salle-College of Saint Benilde, their “friends” and their “friends of friends” during the 2009 through 2013 school years, and how this appears to have added value in knowledge generation. The primary aim is to identify what enhances productiveness in knowledge generation in Philippine Tertiary Education. The phenomenological approach is used, therefore there are no specific research questions or hypotheses proposed in this paper. Considering that knowledge generation is a complex phenomenon, a stochastic modelling approach is also used for the investigation that was developed specifically to study un-deterministic complex systems. A list of salient features for knowledge generation is presented as a result. In addition to these features, various problem types are identified from literature. These are then integrated to provide a proposed framework of inclusive (friendly) and innovative social networks, for knowledge generation in Philippine tertiary education. Such a framework is necessarily multidisciplinary and useful for problem-solving in a globalized and pluralist reality. The implementation of this framework is illustrated in the three parts of the study: Part 1: Online lessons, discussions, and examinations in General Psychology, Introduction to Sociology, and Life and Works of Jose Rizal, for the author’s students in De La Salle-College of Saint Benilde; Part 2: Facebook Report analytics of students and teachers, their friends and their friends of friends via WolframAlpha; and Part 3: Social Network Analysis of the people and groups influencing the courses’ scope-and-sequence in the new General Education Curriculum for Tertiary Schools and Institutions in the Philippines.

Keywords: tacit knowledge, knowledge generation and management, collective learning, inclusive social network, innovation

Introduction

The Economist (2010) used the term “big data” to refer to a collection of data sets so large and complex that it becomes difficult to process using on-hand database management tools or traditional data processing applications. By this definition however, chiefly because of the rapid de-

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velopments in technology, today's big data may be the "medium data" of tomorrow or the ordinarily "small data" by next year. Thus, we can rather think of big data as, different sets or threads of information, files, figures, records, and the like, often involved in social networks.

A review of related literature on knowledge generation shows that social capital and social mobility are motivations in using electronic networks of practice (Ardichvili, et al., 2003; Breschi & Lissoni, 2003; Wasko & Faraj, 2005). As expected, social media may facilitate knowledge generation, depending on the social structure (Cowan & Jonard, 2004). Singh (2003) sees social networks as drivers of knowledge diffusion, and Cowan (2005) suggested network models of innovation for efficient knowledge diffusion, while Guo et al., (2009) analyzed patterns of user content generation in online social networks.

In the Philippines, social networking is one of the most active web-based activities, with Filipinos being declared as among the most active users on a number of web-based social network sites (Liao, 2008). In fact, the use of social networking websites has become so extensive in the Philippines that the country has once been tagged as "The Social Networking Capital of the World". When Friendster was introduced in 2002, millions of Filipinos subscribed to its applications or apps which were mostly games (Liu, 2008). When Facebook was introduced in 2004, tens of millions of Filipinos made their migration from Friendster to Facebook in a few months' time, noting the superior applications or apps that the latter offers. This rate was much faster than the Filipinos' conversion to Christianity in their early history or even to the spread of the Internet itself in Asia! Similarly, upon WolframAlpha's debut in 2009, millions of Filipinos, mostly in tertiary schools and not only in the mathematics and engineering fields but in the social sciences and humanities as well, subscribed to both its selected free apps and apps offered for minimal fees.

Social network analysis of tertiary education in the Philippines is particularly of interest to the author because of the relatively recent developments on Inclusive Education (Savolainen et al., 2012), on Implementing Guidelines of the Psychology Act (Gines, 2006; Kabling, 2010; Tuason et al., 2012), on the upcoming implementation of the new General Education Curriculum by 2018 (Crow & O'Donoghue, 2013; Commission on Higher Education [CHED], 2013); on the ASEAN 2015 (Phusavat et al., 2012), and the recent upgrades of hardware and apps for mobile learning (Chen et al., 2012). Almost all tertiary education institutes, teachers, and in-coming college freshmen in the Philippines, are and will be greatly affected in one way or another.

The author's concern is with what appears to add value in knowledge generation in tertiary education in a globalized world in general, and in the Philippines in particular. Since an exploratory, phenomenological approach is used in this study, there are no specific research problems or hypotheses to test. The primary aim is to describe what enhances productiveness in knowledge generation in tertiary education in a contemporary eastern Asian country—a complex phenomenon that should be approached as one of those un-deterministic complex systems (Saini & Ahmad, 2012; Sommerville et al., 2012).

Part 1: Online lessons, discussions, and examinations in General Psychology, Introduction to Sociology, and Life and Works of Jose Rizal, for the author's students in De La Salle-College of Saint Benilde

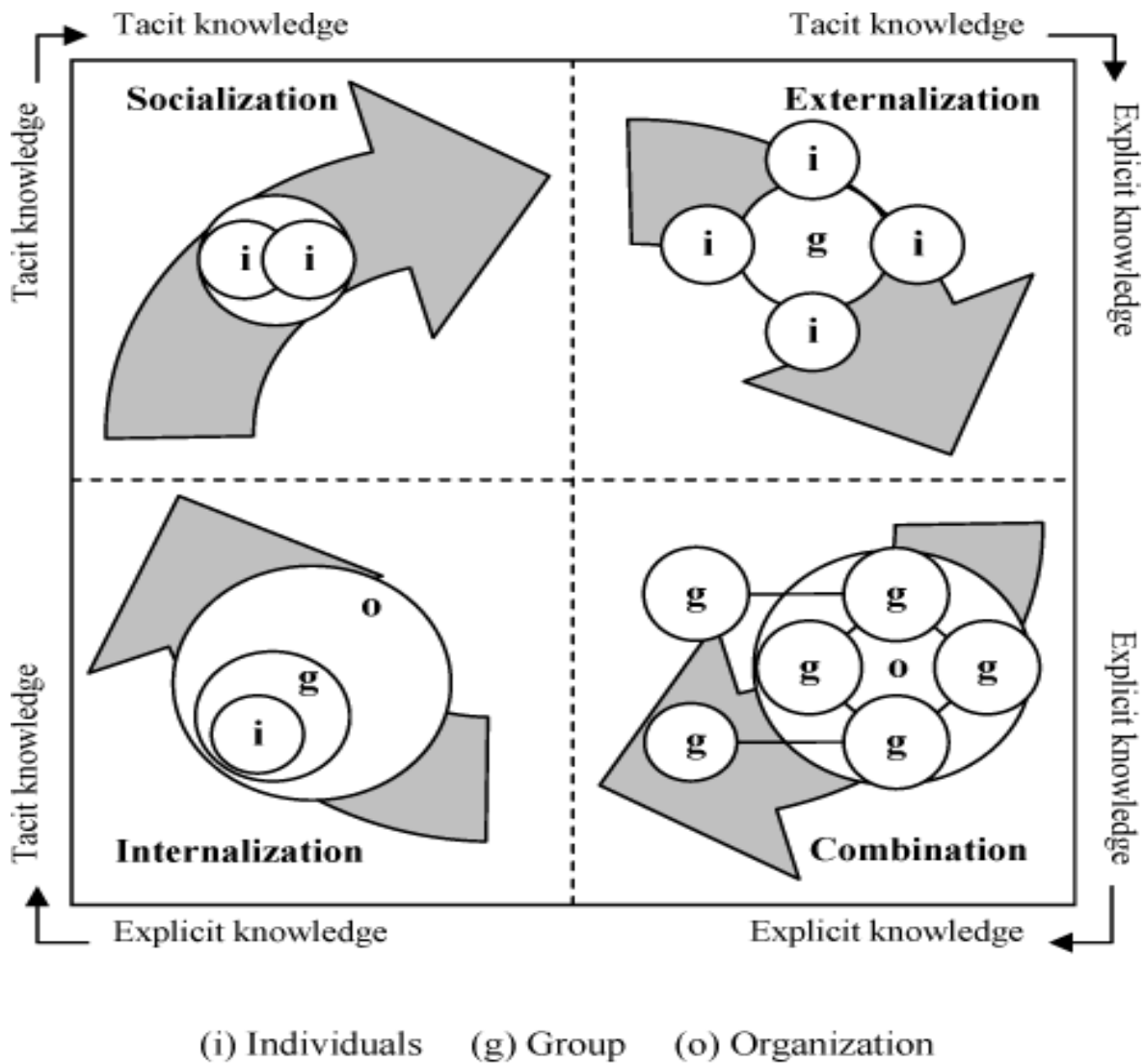
Online teaching in tertiary education in general, and at the De la Salle-College of Saint Benilde in particular, is not new. The author and scores of his colleagues have used WebCT and later

Moodle in classes at the College of Saint Benilde for more than a decade. However, the author, his colleagues and his students increasingly find Moodle to be too restrictive and/or in some ways still a traditional way of teaching. For instance, in Moodle the Administrator can actually exercise authority to restrict what teachers teach. Besides this, since Moodle was created by traditional teachers, it is more designed for traditional pen-and-paper objective type of tests, with only the medium changed. Thus, toward the end of 1st term of the 2013-2014 school year, the author did not utilize Moodle but publicly posted his final examinations on Facebook, not only because each of his randomly selected 200 students has a Facebook account, but more for the reason that Facebook is a relatively more autonomous site of interaction and dialog. DeSchryver et al., (2009) missed an important point: it is the idea behind Facebook that attracted the author and some of his colleagues to use it in teaching, rather than the convenience and power that it offers. The author's online examination items are of the task-based authentic assessment/portfolio type that include designing an exhibit related to an aspect of the course, writing a letter to the editor about a problem that is related to an aspect of the course, constructing a crossword puzzle or similar games wherein the answers are concepts and events connected to the course, etc. The examinations, in general, allow students to choose four out of ten tasks that they would like to work on. Group work for certain tasks were allowed. The scheme received "likes" and various comments, both positive and negative, from a range of Facebook users, from the same school and from other schools in the Philippines.

Earlier, the author also introduced WolframAlpha, a computational knowledge engine he believed could be very useful, to his colleagues and students. WolframAlpha is an online service that answers factual queries directly by computing the answer from externally sourced "curated data", rather than providing a list of documents or web pages that might contain the answer as a search engine like Google will do (Johnson, 2009). Though the author and his students initially found WolframAlpha a bit restrictive compared to Google, they found it more concise and at times even more reliable than certain Wikipedia entries. The author and his students now often use both Facebook applications and WolframAlpha, in connection with knowledge generation—the formation of new ideas through interactions between explicit and tacit knowledge in individual human minds.

In online and offline discussions with his students, the author verified interactions between explicit knowledge, knowledge which can be easily transferred to other learners, and tacit knowledge, knowledge that is very difficult to transfer to other learners. The concept and philosophy of tacit knowledge was discussed in pre-Internet years by Michael Polanyi (1966), and re-discovered and expanded by Nonaka and Takeuchi (1995). Tacit knowledge includes the subjective insights, intuitions, gut feeling, and ideals that are the crucial basis for innovative processes. Furthermore, Nonaka and Toyama (2003) describe knowledge generation to be following a four-part cycle of socialization (tacit to tacit), externalization (tacit to explicit), combination (explicit to explicit), and internalization (explicit to tacit). With tacit knowledge, people are often not aware of the knowledge they possess or how it can be valuable to others. Effective transfer of tacit knowledge generally requires extensive personal contact, regular interaction (Goffin & Koners, 2011), trust (Collins, 2001) and confidence. This kind of knowledge can only be discovered or publicized through practice in a particular context and transmitted through social networks (Schmidt & Hunter, 1993). More-or-less, tacit knowledge "flourishes" when the one possessing it joins a network or a community of practice. Otherwise, that knowledge will be as some liquid that will spill from our hands (Bauman, 2005).

Figure 1: Cycle of Knowledge Generation



Adapted from Nonaka & Toyama (2003)

The above discussion is at the macro level. At the micro- and meso-levels, the dichotomy is not so clear since explicit knowledge is always part of tacit knowledge. To illustrate, during school suspensions (due to inclement weather and other reasons) the author and his students were able to continue interacting via internet and mobile devices. Assignments were submitted and examinations were taken online and/or via mobile devices. Similarly, when the author was on official business in Zurich (Applications of Social Network Analysis 2013) last August 2013, he was still able to administer the scheduled final examinations to his students in Manila, online and/or via mobile devices. In both cases, evaluation results show explicit knowledge was indeed learned by his students online, but the evaluation results also show that tacit knowledge—knowledge that are very difficult to transfer—was not well learned by his students. For instance, most of his students in General Psychology sketched their designs of a psychology room for the school, but did not incorporate a fire exit and other salient features of a psychology room; some of his sociology students who chose to design cakes honoring famous sociologists or illustrate a sociological concept did so, but only one culinary arts major actually baked some cookies shaped like the head of Karl Marx, and explained her choice of ingredients.

There were earlier offline interactions between teacher and his students and their friends, in their visits to museums and exhibits, kite construction and kite flying sessions, shell gathering, etc. In these offline interactions, many of his students gained a variety of tacit knowledge. Focused group discussions in Facebook by the author with his students and other teachers and educators tackled the special emergent roles professors should play in the coming years. Teachers in tertiary education should be more like motivators and have informal activities with their students, which online applications alone still cannot do.

Incidentally, one of the Facebook friends of the author's 200 students who participated in the study is blind. She eventually became one of the author's students in the latter school term. Though sightless, she is able to participate in Facebook discussions through her shadow teacher, and when alone, through a screen reading software such as Jaws and WindowEyes that converts text to speech and allows her to navigate the computer using only the keyboard. She has a number of friends on Facebook; some of them are likewise blind. It is interesting to note that at present, the college where the author is affiliated has three blind enrollees, and all three appear to be using Facebook applications all the time. They have been accepted in the school as part of the institution's reorientation of making itself more inclusive to all types of learners including those with special needs (Tolentino et al., 2013). In this regard, the author and his colleagues have recently incorporated coursework that requires students to come up with actual posters intended to educate people about those with special needs.

As expected, this study finds the correlation between student performance (as measured in their final grades) and mobility (hours use of mobile phone and mobile applications) to be high (.627, N= 200). Online focused group discussion by the author with his students validated that high-performing students often use mobile devices and mobile apps in online and offline interactions with their peers and their teachers. As expected, high-performing students and students who frequently use mobile devices, cluster together. This is mostly likely due to homophily—people of similar abilities or who engage in similar activities, prefer associating and bonding with one another, than with other people, often expressed in the adage “birds of a feather flock together” (McPherson, Smith-Lovin, and Cook, 2001).

The author, however, does not think homophily alone explains why high-performing students and students who frequently use mobile devices, cluster together. It can also be explained in terms of social capital (Ellison et al., 2007) since most college students find the use of online

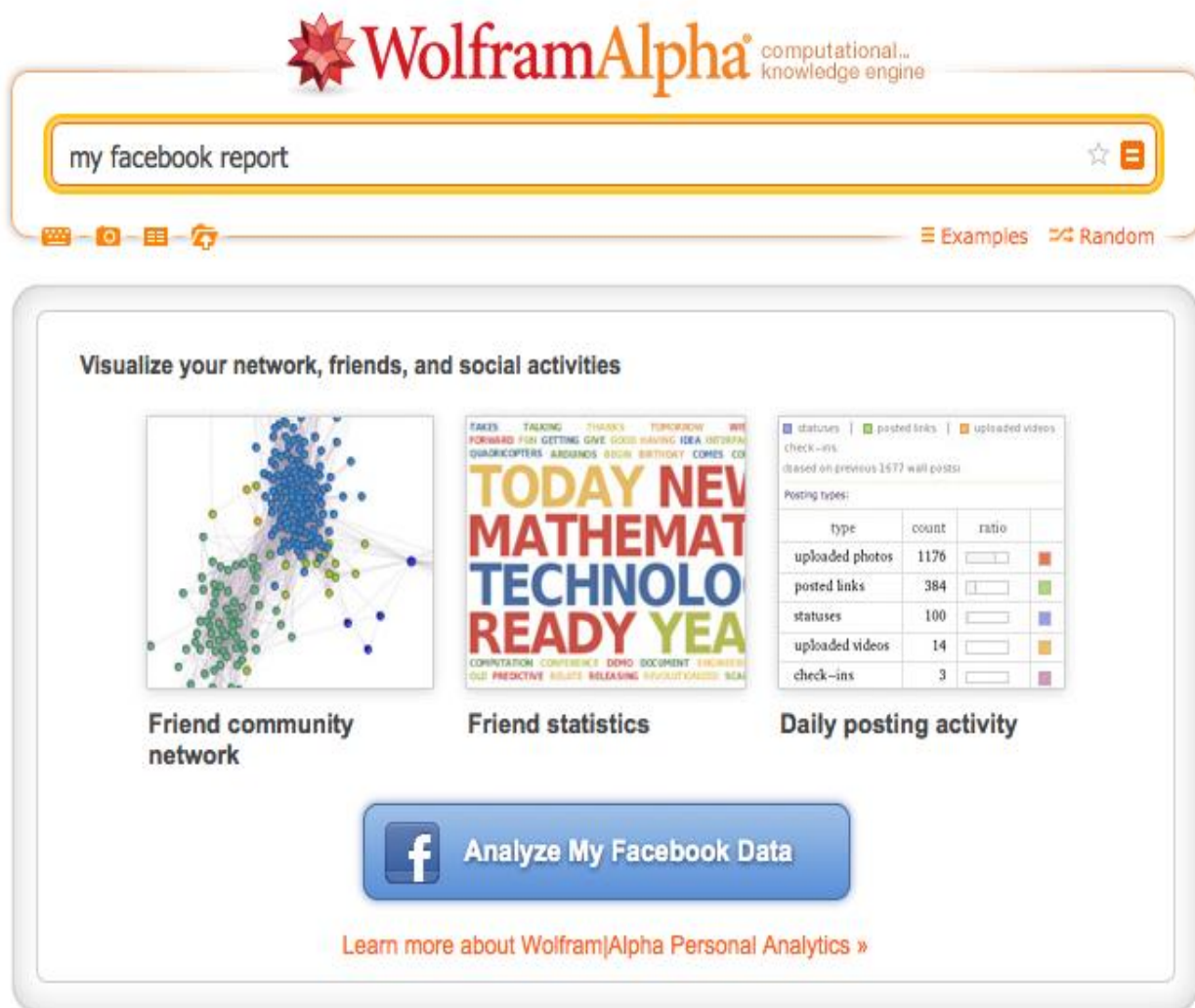
social network sites to be beneficial in making connections, as does having Facebook “friends” of various degrees.

There were cases too of false positives in the study. Some students admitted getting high grades because the general education subjects they took for the term happened to be relatively easier than other subjects, who are also using their mobile phones more often, to share information with those schoolmates they are amorously involved with.

Part 2: Facebook Report Analytics of students and teachers, their friends and their friends of friends via WolframAlpha

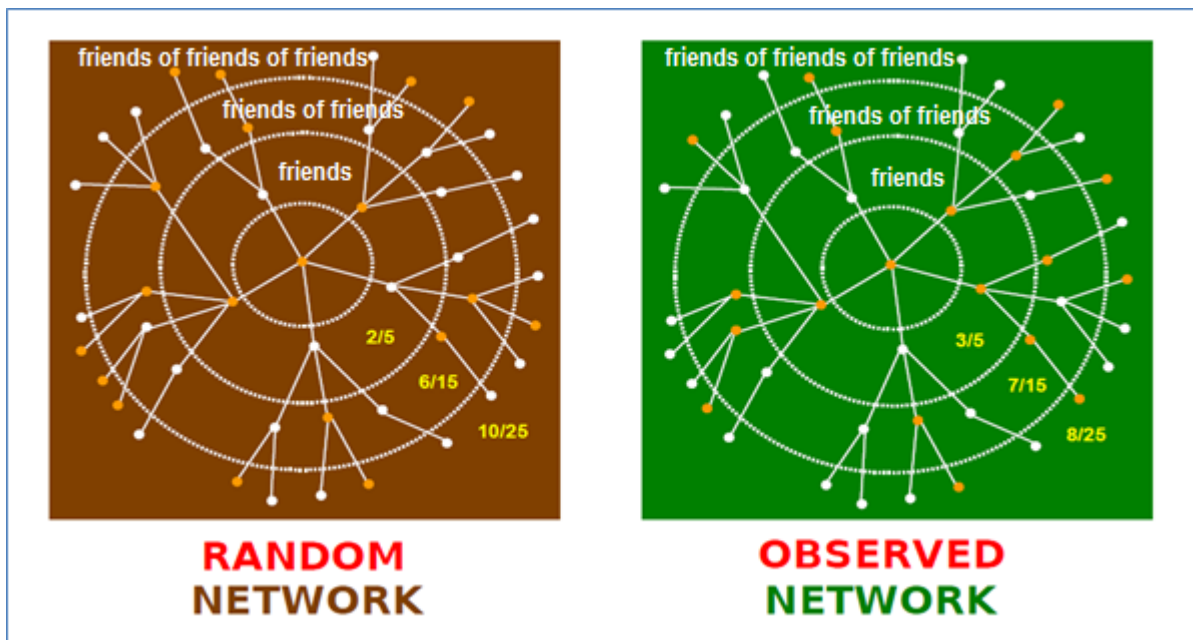
When WolframAlpha started offering Facebook analytics as one of its free services, the author instructed his selected 200 students (those with both FB and WolframAlpha accounts) to obtain their FB Report analytics, and discuss what appears to augment knowledge generation in the course or courses they were currently enrolled with the author.

Figure 2: WolframAlpha’s Facebook Data Analytics



Based on, changes in word clouds in time, among other elements, the author and his students observed knowledge and information exchanges from Facebook posts and comments on the said posts, from students and teachers from other schools. In fact, a lot of knowledge and information is exchanged between people at various institutions all over the country and even from other countries. They are shared not only by friends, but even by friends of friends. Additionally, much information shared between friends is multidisciplinary in scope, with topics including: local and international politics, local and foreign celebrities, economics, health, LGBT issues, religion, sports, astronomy, marine science, etc. The significant changes in word clouds over time for most of the 200 students, among others, show that the influence on students and faculty come not only from their close friends, but from their friends' close friends as well.

Figure 3: Stochastic Modelling of knowledge transfer to friends, to friends of friends, and beyond



The author also made use of the class record of his students to evaluate informational and other exchanges. Correlation between the grades (both midterm and final grades) and the dispersion indices, show that students learn more if the friends of their close friends do not belong to the same clusters. Further, as in the midterm and final grades, there are indications that students learn more (i.e., exhibit greater change in word cloud densities) if the friends of their friends do not belong to the same clusters (i.e., if their friends of friends are not strongly connected or not connected at all). These indications come from examining WolframAlpha's Facebook Report analytics (in word cloud densities and actual comments of the student like, "I didn't know that," "Wow, I learned something new today!", "That is definitely a spot on"), Moreso than Granovetter's explanation (1973) of the strength of weak ties, the aforementioned implies that the ideal college teacher or professor is someone who is expanding his or her students' worlds.

While the transfer of knowledge between the person and his friends (1° of separation) and to his friends of friends (2° of separation) is definitely greater than chance, WolframAlpha's Facebook analytics also show that beyond friends of friends (3° of separation or more) knowledge transmission rates deteriorate rapidly and the transfer of information becomes more random. Most likely, people simply get tired and satiated from interacting about the same topic unless there is new information or innovations involved.

The author's focused group discussions with his students and their friends who have been using Facebook, Yahoo and/or Gmail for several years indicate that on the average, students disengage themselves (unfriend or reduce their friendship status from "close friend" to "acquaintance" to "restricted") from their former teachers and classmates after two school terms (or about eight months) for a variety of reasons ranging from: "getting offended at the person's blog or comment", to "getting too attached"; to "restrict them to public postings to protect one's privacy", to "preventing too much news feeds from someone I'm not that concerned", to "got tired of the person" and "started losing interest". Consequently, the tacit knowledge from the disengaged person is likewise severed.

Online inquiry of the author into each of his 200 students' types of friends, indicated that the number of a student's Facebook close friends is more-or-less five (mean=5.42, standard deviation=1.01921 by normative statistics; 5 by network stochastic modeling and this number is significantly higher than what is obtained by random walk). Further online inquiries show that the number of a student's close friends, in general, do not significantly increase even with an increase in the number of the other types of Facebook friends (i.e., acquaintance and restricted friends), nor with an increase in the number of online friends of friends. Even the author, who has nearly a thousand-and-seven hundred (1,700) friends as of December 2013, frequently delimits his close friends to just nine (9). On the other extreme, the blind student of the author with whom the author has seven (7) mutual friends, has less than twenty friends, and only four (4) of them has she designated close friends. Herein, being "friendly"—i.e., having many Facebook friends of various degrees—appears to add value in knowledge generation in tertiary education. The author is aware of the strength of weak ties (Granovetter, 1973), i.e., that new ideas actually come not from our close friends but more likely from a friend of one of our friends with whom we have barely interacted with. But those new ideas must be of the explicit type of knowledge, and not tacit knowledge. Tacit knowledge truly comes from intensive interaction with one's close friends. The ideal is, unquestionably, that one learns something new—explicit knowledge—from a friend of a friend. Then, after increased interaction and confidence, that friend of a friend may eventually become a close friend from whom one and the others acquire tacit knowledge. Then and there, that particular tacit knowledge is captured in the community.

Part 3: Social Network Analysis of the people and groups influencing courses' Scope-and-Sequence in Tertiary Education in the Philippines in its new General Education Curriculum

As observed by the author via occasional Facebook newsfeeds and Twitter tweets that he has been receiving since 2011, many of his 200 selected students have siblings and "friends" and "friends of friends" who are concerned about the possible effects of the transition to the new General Education Curriculum in Tertiary Education, which will be implemented nationwide in the school year 2018-2019.

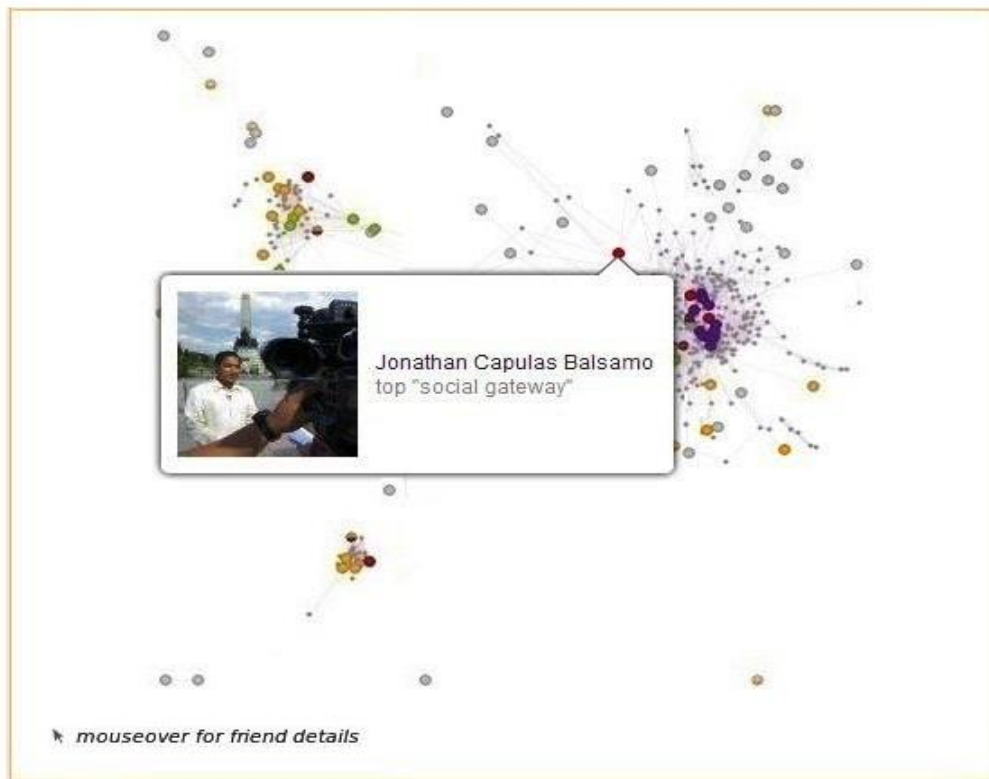
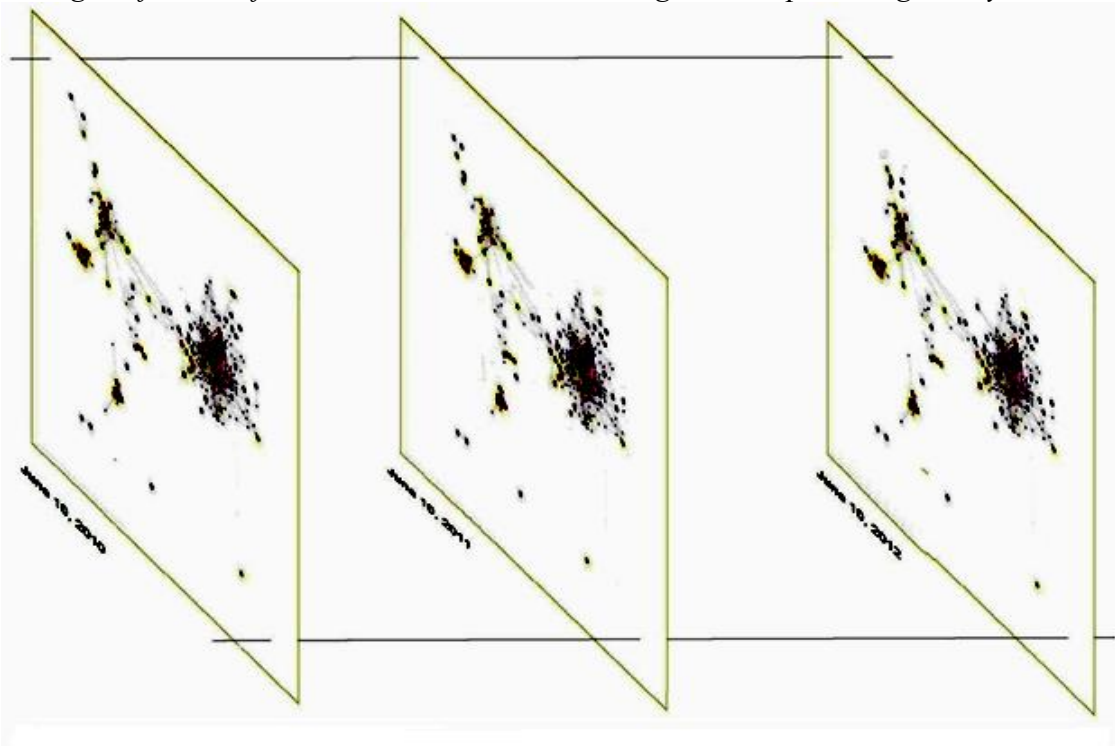
As a consequence of the K-12 Program (Kindergarten plus 12 years of Basic Education) of the Department of Education that began to be implemented in June of 2012, the General Education Curriculum in Tertiary Education has to be revised in scope. Many of the General Education subjects have been moved down to the Senior Secondary School level, and the content of the retained or otherwise new courses in tertiary education will have to be agreed upon after some debate and deliberation.

One course of particular interest to the author and his colleagues is the course on the life and works of Jose Rizal. This course has been taught for decades, and many have the firm conviction that Rizal's values and ideals should be taught in college. There has been a revival of the move to repeal the Rizal Law (Pangalangan, 2010), to abolish the Rizal Course in College, and a bicameral committee has been assigned to address the issue. Some educators like Napoleon Imperial of the Commission on Higher Education (CHED), have expressed that they are amenable to simply relegating the teaching of the life and works of Rizal to the new secondary education curriculum "to enable college students to concentrate on their majors". Fortuitously, the Knights of Rizal earlier made a probably the most crucial move post mortem—the conferment of membership with the rank of Knight Grand Cross of Rizal last February 2011 to the President of the Republic, Simeon Benigno Aquino III during 2011 International Assembly and Conference on Rizal which was also an occasion for a pre-celebration and planning of the 150th Birth Anniversary of Rizal. In his acceptance speech, President Aquino thanked the Knights of Rizal and highlighted the relevance of Rizal's ideals in the present time of Philippine history, and the need for the Filipino youth to know them by heart.

Using Marc Smith's Network Patterns of Social Media (2013) the author noted that the Department of Education Culture and Sports (DECS) and Commission on Higher Education (CHED) are merging 'big clusters' that are acting as broadcast sources, whereas many tertiary schools act as sinks. Parallel social network analysis using WolframAlpha's Facebook Report analytics focused on other clustering patterns amongst educators and institutional stake holders. Social insiders, social outsiders, information gatekeepers, other information sources and information sinks were also identified. The active presence of literary figures and historians (like the nonagenarian F. Sionil Jose and the very young Jonathan Capulas Balsamo, formerly of Enderun Colleges) in the network, plus the National Historical Institute databank access, assure both sufficient collective memory on the historical aspect of the scope-and-sequence of the tertiary education curriculum in the Philippines, and sufficient tacit knowledge to transmit and propagate.

Based on the analysis of the social network of educators, college teachers, and their friends and friends of friends, the author made a forecast in one of his earlier Facebook blogs (<https://www.facebook.com/media/set/edit/a.10200681820913541.205148.1401550232/>) that the Course on the Life and Works of Jose Rizal will be retained, despite the formidable move by some congressmen, senators and other prominent people to repeal Republic Act 1425 and abolish the teaching of the Rizal Course in Tertiary Education. It is because the President has become close friends with many of the member of the Knights of Rizal, of the descendants of the Rizal Family, and of the Rizalists-alumni of Ateneo de Manila (both Rizal and President Aquino are themselves alumni of Ateneo). True enough, on May 15, 2013, when President Aquino signed the Enhanced Basic Education Act of 2013 into a law, the provision for the retention of the Rizal Course in college was inserted.

Figure 4: Visualization of a network of Facebook friends in time via WolframAlpha showing who among the friends of the author is at one time acting as the top social gateway



Earlier, in private messages via Facebook and Gmail by the author to some members of the Knights of Rizal, he suggested that they refrain from wasting their time in convincing or debating with specific people identified as social outsiders and neighbors (i.e., with betweenness centrality of nearly 1 or 0) but rather concentrate on interacting more (online and offline) with the President of the country who, after all, can veto the decisions of the bicameral committee regarding the new tertiary education curriculum.

In the conduct of the course on the life and works of Rizal by the author and his colleagues, they include a joint critique by the student and the course professor, of the current societal ills and problems. In past terms, they even included concrete solutions carried out by the students such as voters' education program for a then incoming national elections, and a poster campaign against illegal child labor practices. Decades of experience by the author and his colleagues prove that the joint students-professor critiquing as a course component can be very rich in tacit knowledge. Students can learn to conduct research, how to commute by themselves to libraries and historical sites, or make souvenir items for museums' and exhibits' business venture.

Conclusion

The conclusions of this study are as follows:

Firstly: in tertiary education in particular, close friends, and friends' close friends are an educational resource. We learn something new from them, and our friends' close friends learn new explicit knowledge from us as well. Having many social network friends of various degrees adds value in knowledge generation in tertiary education.

Secondly: aside from explicit knowledge, tacit knowledge is revealed only through practice in a particular context and transmitted through social networks including close friends. In tertiary education, tacit knowledge will flourish when the ones possessing the knowledge join a network or a community of practice with friendships of various degrees.

Thirdly: the number of one's close friends does not significantly increase with the use of Facebook, Yahoo and/or Gmail. It appears that individuals suffer from information and knowledge overload when they receive more than they can handle, and/or they get tired and satiated from engaging the same sets of information too often or for too long, prompting individuals to disengage unless they learn something new from the person periodically. Innovation in itself also adds value in knowledge generation in tertiary education.

Lastly: an ideal tertiary education teacher is someone who is able to connect with various types of learners (in accordance with inclusive education principles); who broadens the student's worlds in a globalized and pluralist reality without causing information and knowledge overload, and may be contacted anytime anywhere (i.e., has high dispersion and mobility indices) by his or her students for them to learn something new each time.

Recommendations

Since tacit knowledge do flourish when the ones possessing the knowledge join a network or a community of practice and such needs infrastructure, it is recommended that tertiary education should include sufficient budget for inclusive infrastructure and software applications to create friendship-rich social networks. This is more than simply enjoining faculty members and stu-

dents to become more broadly and efficiently connected and mobile with their personal electronic devices.

It is also recommended that collective learning, collective decision-making, collective memory and mobility of students and faculty members with their social network friends of various degrees (or even peer tutors and other school personnel) should be investigated more closely in tertiary education, using appropriate network statistics rather than normative statistics. Finally, offline teacher-student, teacher-teacher, and student-student interactions (whether inter-school or intra-school) should not be neglected in tertiary education, especially those involving tacit knowledge. Neglect of institutions, groups and individuals who are tacit knowledge possessors, and the offline interactions with them, shall lead to silent but extensive knowledge loss (DeLong, 2004) as our society lapses to an Asian version of liquid modernity (Bauman, 2000). In the Philippines, there is no better time than now to consider the above and implement the corresponding reforms, as there is already an enabling law requiring 12 years of basic education whose first graduates will enter college by 2018. Failure to seize the moment now may waste a tremendous amount of resources. Worse, lack of decisive collective action now may push the Philippines back to having a regressive, reactionary tertiary education.

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