

ONLINE TECHNOLOGIES AND KNOWLEDGE PRODUCTION IN THE NATURAL SCIENCES

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Abstract

Epistemic communities consist of structures and selectivities in citation and referencing that scientists as “practical and economic reasoners” use in order to establish scientific credit and capital in their specialized field. Knowledge then becomes a product of social and economic shaping based on “selectivities,” or decision-making processes in the epistemic community. This paper looks at the use of online resources (i.e., journal databases) in the natural sciences programs (i.e., physics, chemistry, and biology) of two Philippine universities, through key informant interviews with graduating students, thesis advisers, and library personnel. In this context, scientific credit and capital are gained by researchers from the credibility of the resources that they use (i.e., authors and research institutions cited in their thesis), although this is limited by the availability of resources in the universities. The availability of online materials is associated with functional meanings such as convenience. Meanwhile, the substantive meanings of the availability of online resources show the dilemma of universities in balancing costs and research independence, since findings show that the online usage in both universities is insufficient to maximize the costs spent in purchasing the online resources. The first university values knowledge production more than cost-efficiency in the acquisition of references, thus, the structure of knowledge production is more accommodating to the selectivities of its researchers. In contrast, it is seen that the structure of knowledge production in the second university regard costs as more important. This causes its researchers to use non-online materials.

INTRODUCTION

The incorporation of the internet in epistemic communities has shaped the trends in research and knowledge production, especially since the internet was launched in 1991. In the academe, online databases of research journals have been introduced to libraries for students and teachers alike, through an updated roster of journals published worldwide. Currently, few universities offer online databases in their libraries: Ateneo de Manila University, University

of the Philippines, De La Salle University, and University of Santo Tomas.

This study contributes to the sociology of science and technology which is an emerging area of discourse, especially in the Philippines. Since the trend of making online technologies available in university libraries has been relatively new, analysis of its utilization and contribution to the knowledge community should be undertaken. For the universities that were studied, the findings

and analysis would be helpful in their respective evaluations on making and maintaining the online resources available in their libraries. For the research community in the Philippines, this study offers an insight into the dimensions of existing resource-sharing mechanisms.

In comparing the emerging knowledge production cultures brought about by the online technologies in the two universities, this study utilizes microsociological and social constructivist approaches (Knorr Cetina 1981). In these approaches, the researchers are "practical reasoners" who continuously attempt to situate themselves in an established epistemic community, through citations and incorporation of existing academic works into the formation of new knowledge in the field. This is most evident in universities when students work on their theses, with their thesis advisers and the university leading them to possible sources. In these cases, research is intensively taking referencing into account.

The universities chosen for this study have similar program offerings for the natural sciences and online databases available in their libraries (i.e., EBSCO). The study examines and compares the resulting research practice in two of the universities aforementioned with the availability of online resources as an intervening factor. It is guided by these research questions:

- a. Comparing the two universities, how do students utilize technology through online databases in making their theses as contributions to the body of knowledge?
- b. How do thesis advisers in both universities influence the levels of selectivity in both making online journals available, and having the resources accessed by their students?
- c. How do structures of knowledge production in universities affect referencing in thesis-making?

Research Framework and Design

This study uses the micro-sociological approach (Knorr Cetina 1981) which focuses on "contextual contingencies," or "contextualities." Knorr Cetina argues that the construction of science (knowledge) is determined by the background, history, interests, and motivations of the institutions and agencies involved, as determined by their respective epistemic communities. These contextualities could be observed through the levels of decision-making, which Knorr Cetina calls "selectivities." These selectivities are always changing according to social, economic, and political factors, and that prior decisions affect the succeeding ones, such that selectivities, accordingly, is in progressive process of complexification.

Knorr Cetina (1981) characterizes an "epistemic community" as a specialized group which shares a common stock of knowledge and procedures, and presumably common standards of evaluation, professional preferences, and ways of making a judgment. These groups, accordingly, are scientific communities that are relevant social and cognitive organization in science. The key concern of studying epistemic communities is the identification of integrating mechanisms as practiced through citation and patterns of selective

referencing. References are taken to represent relations of intellectual indebtedness within the network of the knowledge-producing scientists. Therefore, it is seen that epistemic communities—their structures and prioritized values—determine the dimensions of its own knowledge production.

One way of understanding knowledge production is through what Saloma-Akpedonu (2006) describes as the process of “doing technology,” technology in this sense encompassing the concept of knowledge. She says that “doing technology” should expand its notion into including not just the consumption of these technologies, but also the processes and activities that produce them. Accordingly, this implies production and the awareness of one’s own self and the creative ability to negotiate meanings, shape identities, and to act upon these. Thus, it is seen how both the structure (i.e., the processes and regulations on producing and acquiring research references), and scientist (i.e., the social position of researcher) both influence the production of knowledge.

In this study, the concept of epistemic communities could be seen in two levels: (a) epistemic community within a university, and (b) the overall epistemic community in the Philippines (i.e., among universities). This study would also extend the meaning of epistemic community, such that it does not only involve the citation in written works. This study would also refer to oral or face-to-face referencing (i.e., recommendations of thesis advisers to their students, recommendations of thesis advisers to their colleagues, shared resources

between and among teachers), in order to describe the structures of knowledge production in epistemic communities within universities.

Moreover, this study is focused on the production stage of knowledge, such that it is assumed that when researchers have better access to resources—in terms of quality and quantity of available sources—they would be able to produce better researches. The basis of the findings in this study is not the number of researches, because it is given that in a university setting, both teachers and students are required to produce researches. Instead, this study looks at the beginnings of the research process, and how the factors affecting both the structures in universities and the researchers translate to knowledge production.

In research, knowledge is considered as a reconstruction of existing knowledge, accruing as more and more researchers contribute to the existing knowledge. Knorr Cetina (1981) points out two sources of such reconstruction. The internal source refers to scientists as “practical reasoners” who consider acquiring scientific credit in their process of citation and referencing for their researches. As a form of symbolic capital, scientific credit is described as the recognition and acceptance of a researcher (or the new knowledge produced) in an established scientific community. As a form of symbolic capital, scientific credit is acquired by scientific agents through the imposition of technical definitions and legitimate representations of scientific objects in the field. Therefore, acquiring scientific credit could be considered as capital through being cited,

or choosing credible sources for citation and referencing. The standards of credibility differ according to specific epistemic communities.

The epistemic community of science engages in discourse through written communication. In each decision in the selectivity, economic factors and discourse are deemed important. Such economic and historical contexts are the external sources of reconstruction, therefore making scientists "economic reasoners." Both internal and external sources work in a dialectical manner to shape science and technology.

The economic aspect of knowledge production in epistemic communities could be better explained through MacKenzie and Wajcman's (1999) "social shaping of science and technology." This means that both costs and benefits are determining factors in the process of constructing knowledge, such that institutions are affected by their monetary capacity, as well as the existence of support systems that would forward the scientific endeavor. This study adopts these concepts by looking into the practical and economic reasoning of the actors in the epistemic communities.

In describing the effects of science and technology in knowledge production, this study utilizes the concepts of "functional" and "substantive" rationality (Pertierra et al. 2002). The functional rationality of everyday life may manifest in terms of convenience, confidentiality, and instant access (Saloma 2002). However, it is not automatic that substantive rationality changes with functional rationality. The meaning of science and technology is therefore determined with how the

technology is consumed to develop the public sphere, that is, a realm of the social life in which something approaching public opinion can be formed (Pusey 1993).

Pertierra (2003) also observes that although science and technology are expressions of structural and cultural orientations, the rationalization of socio-cultural structures has not sufficiently forwarded autonomous discourses to operate within their respective areas. Science and technology in the Philippines benefit those who have appropriate competencies or capital resources, reflecting constructionism based on the sociopolitical context that generated them. Despite this, he points out to the optimism of Filipinos about the future of science, such that the insufficiencies in the state of science and technology in the present opens much room for improvement for people involved in them (i.e., unexplored opportunities, "potentially good students," lack of financial support from the government).

This study focuses on the natural sciences departments of two of the three universities in the Philippines that provide online databases in their respective libraries. Key informants, chosen using the snowball technique in data gathering, are comprised of undergraduate students completing their thesis requirement during the time of data collection, their respective thesis advisers, and library personnel who are in charge of the maintenance and documentation of either the online databases or the printed journal collection.

It particularly looks at thesis production in the natural science programs (i.e., physics, chemistry, and

biology), since these areas have specific online databases and printed journals available in the libraries.¹ Due to the specificity of the subject areas, these databases are accessed by groups specializing in the respective courses.

University A.² This university provides the largest collection of online databases in the Philippines today. It has specific online databases for the natural sciences such as *American Chemistry Society (ACS) Legacy Archives* for Chemistry; *American Institute of Physics (AIP)* for Physics; and *Current Contents ISI®: Agriculture, Biology, & Environmental Sciences* for Biology.

However, even if University A is slowly shifting to online databases for its library, it still purchases and makes available the printed versions of journals in its library – whether or not the journals are included in the online databases.

University B. University B offers only two databases: EBSCO and CIPPA.³ The two databases are backed up by its *Millennium*⁴ and *B-Project*,⁵ software databases that catalogue all printed journals, including graduate theses, in its library. The programs operate like online databases (i.e., search options include encoding a word, with all possible results appearing automatically).

DIMENSIONS OF KNOWLEDGE PRODUCTION

This section discusses the functional and substantive dimensions of knowledge production. The functional dimension is represented by research efficiency as a result of the availability of online references. Meanwhile, the substantive

dimension corresponds to economic shaping (i.e., cost-efficiency in acquiring references), and social shaping (i.e., the factors on the non-utilization of the online databases in the universities) of knowledge.

Functional Meaning: Efficiency in Time and Effort

Looking for references in the online databases makes the theoretical framing stages of research more convenient, compared to when references are searched manually in the printed collections of journals. Updated online databases widen the scope of research. One student said:

“You search for one keyword and almost all the information you need [would] be served to you. I do not think it makes us lazy with our research. You could always make use of online references to forward a good research.”

University A students said that they “almost always” find the resources that they need in their library because of the wide range of selections – both printed and online. They said that the printed materials their thesis advisers recommend are in the library, and in the case they would need extra sources, they would look for the supplementary information in the journals in the online databases.

The preference of using online materials was also observed in University B. The University invested in online databases to follow the trend of digitization in Philippine universities. The students in University B also “demand” for a faster search and retrieval mechanism in the library, to which the online databases are a response. This is a

function of the role of the university in forwarding a more research-conducive environment for its students through the convenience of the online technologies, in order to situate themselves more into the larger epistemic community.

The efficiency in time and effort brought about by availability of online resources is functional in nature. But more than the functional meanings, the substantive meanings that arise are more determining of the dimensions of knowledge production in the epistemic communities in the universities. These substantive meanings are seen in the economic and social contingencies that affect the selectivities in both universities.

Economic Shaping: Maximizing Costs

Table 1 describes the costs of online database acquisition, while Table 2 summarizes the costs of reference acquisition for the library of University A.⁶

Some of the online journals indicated in Table 1 are also available in the University B library. Based on the serial and online collections of both universities, it could also be assumed that the cost for reference acquisition of University A is more or less the same for University B (Table 2). Therefore, both universities spend a large amount of money every year to sustain subscription of the references, both online and printed. Given the costs, library personnel say that both universities are working on a limited budget to secure all the references recommended by their respective academic departments. In both instances, there are two factors being dealt with by the universities: first, the costs of the

acquisitions, and second, the relevance of the materials to be purchased in developing their respective epistemic communities.

Both universities maintain a certain number of serial subscriptions in their respective libraries. For academic year 2006-2007, the total number of serial titles in University A is 736, while University B has 273. Given this, both Universities want to avoid duplication of available journals. In University A, there is a movement towards prioritizing the acquisition of online references over printed materials, however, even if there are journals already covered by the online databases, University A would still purchase the printed versions. This is because the online versions of the journals are not always complete (i.e., some come in full-text version, others in abstracts only). A key informant from the library in University A said that if a researcher finds the full text of the journal unavailable in the online database, then the library personnel would check if it is available in the printed collections; in this case easily providing the researcher with his/her reference. In this case, the printed versions of the journals function as supplementary resources to the online databases. University A library considers this "necessary" in order to "induce comprehensive research" and "convenient resource gathering" in the University, despite the costs that duplication of resources entail. Although, contacting the authors of the journal entries through the e-mail addresses provided in the online database is an open option for researchers.⁷ Therefore, University A ranks the creation of

Table 1. Costing of Online Resources of University A

TITLE	MODE OF ACCESS	PRICE (US DOLLARS)
American Chemical Society Online Journal Package	ONLINE SITE LICENSE	3,025.00
American Chemical Society Online Journal Package (Archive)	ONLINE SITE LICENSE	457.00
ACM Digital Library Core Package	ONLINE SITE LICENSE	8,108.63
IEEE /IEE Electronic Library	ONLINE SITE LICENSE	26,500.00
Proquest Philosophers Index	CD-ROM	1,541.00
American Institute of Physics/American Physical Society Online Journal Package	ONLINE SITE LICENSE	4,400.00
American Institute of Physics/American Physical Society Online Journal Package (Archive)	ONLINE SITE LICENSE	512.00
Institute of Physics Historic Archives	ONLINE SITE LICENSE	1,233.96
PROLA (Physical Reviews Online)	ONLINE SITE LICENSE	350.00
PsycArticles (Ebscohost)	ONLINE SITE LICENSE	6,500.00
PsycInfo (Ebscohost)	ONLINE SITE LICENSE	7,150.00
Academic Periodicals Collection (Included in Academic Search Full Text Premier subscription)	DVD-ROM	Gratis
Academic Search Full Text Premier (Ebscohost)	ONLINE SITE LICENSE	16,800.00
Biomedical Reference Collection: Basic (Ebscohost)	ONLINE SITE LICENSE	Gratis
Business Source Premier (Ebscohost)	ONLINE SITE LICENSE	6,000.00
Computer Source (Ebscohost)	ONLINE SITE LICENSE	Gratis
Current Contents Connect (Life Sciences, Agriculture, Biology & Environmental Sciences, Physical, Chemical, & Earth Sciences)	ONLINE (4 USER LICENSE)	8,704.00
Encyclopedia Britannica Online	ONLINE SITE LICENSE	1,650.00
ERIC (Ebscohost)	ONLINE SITE LICENSE	Gratis
JSTOR	ONLINE SITE LICENSE	2,750.00
MAS Ultra School Edition (Ebscohost)	ONLINE SITE LICENSE	Gratis
Proquest Digital Dissertations	ONLINE SITE LICENSE	5,980.00
Regional Business News (Ebscohost)	ONLINE SITE LICENSE	Gratis
SwetsWise	ONLINE SITE LICENSE	700.00
ITS for Windows		1,710.00

Source: University A Library Acquisition Section

Table 2. Costs for Reference Acquisition for University A

Printed Journals/Serials	
AY 2004-05	Php 9,200,088.51
AY 2005-06	Php 14,388,381.76
Online Databases	
AY 2005-06	US\$ 104,071.59 (Php 5,307,651.09*)

scientific capital higher than economic costs, which contribute to its scientific capital in the local and larger epistemic communities.

University A, on one hand, acquires all possible research references for its faculty and students, reaching an extent of academic independence. In this sense, the university does not depend on other universities or other institutions to supplement the resources that its researchers would need, since all the materials are already present in the university library. The university maintains this independence even if there are cases of duplication and increasing costs. It is because the availability of resources is very important especially to the natural sciences where research topics are very diverse and particular. The journals on particular topics will therefore be used only when a researcher has a study with a related topic.

University B, on the other hand, ranks economic factors more in its selectivity on reference acquisition. But it provided the *Millennium* and *B-Project* that catalogues all the printed journals and graduate theses and dissertations available in its library for more convenient access to resources. Moreover, as University B recognizes this "limitedness," thesis advisers refer their

students to University of the Philippines-Los Baños (UPLB) or University of the Philippines-Diliman (UPD) in cases when the journals needed are listed in University B's EBSCO list but are not available in their printed collection. In these two University of the Philippines campuses, while there are no online databases available, their libraries provide a comprehensive collection of printed journals. According to a library staff and a thesis adviser, the Department of Science and Technology (DOST) organized a consortium of universities of which University B is a member. Each university is assigned to maintain particular collection. University B is assigned to maintain the collection of chemical abstracts and journals, therefore it would have to refer to other universities for other subject areas. University A, on the other hand, is a non-participant in this scheme organized by the DOST. As aforementioned, it purchases the references—both online and printed—for its research independence.

The economic shaping in the context of this study points out that the maximization of costs for both universities is relative to what is the higher factor of selectivity they adhere to. For University A, it is vastness of references for more convenient referencing and research

despite the costs. What University A considers as maximization of costs is acquiring as much references that would assist the knowledge production of its students and teachers. In contrast, for University B, maximization of costs means the allocation of limited monetary resources which is premised on its attempt to expand their reference selection through a consortium with other universities.

Social Shaping: Inefficiency and Non-utilization

For both universities, the online resources are not sufficiently utilized by the students. The following tables present a summary of the relationships between and among the projected user population of the universities, the number of accesses in the online database which both Universities have, and the number of accesses to the serials (i.e., printed journals). The tables also compare the average use per student of both online and printed serials.

In both universities, online usage is greater than the use of printed materials.⁸ However, juxtaposing the number of expected student users with the total accesses, both online and serial references are not sufficiently utilized, according to the average use per student of both materials (Table 3). This evident in University B (Table 3 and 4), where the population is higher (compared to University A), but the access rate of online and serial materials is much lower. Despite relatively higher counts of accesses and downloads from online resources, the library in University A is still concerned about improving the utilization of the resources, because

“more accesses means that the cost per access will decrease.”²

Lack of information. A University A student used *scholar.google.com*³ for choosing the topic and theoretical framework of his research because it was the reference introduced during a university plenary for natural sciences students. The staff introduced EBSCO instead of online databases for the natural sciences such as *Current Contents*. “I could have used them if I only knew they existed,” he said. Another student said that he is aware of the online databases in the library, although what he understood was that the databases were useful “only to students of the Social Sciences.” Therefore, the lack of awareness of University A students could be traced to (1) unclear information on available databases from the library, and/or (2) thesis advisers, because they do not recommend the databases in the library.

The library personnel in University A say that students should be aware of the online databases because library tours are being conducted for every freshman batch. However, students say that the tours are not very helpful, such that, “it only informs (the students) that there are online databases, but what they are for, what we could find in them, and what subject areas we could use them for are unclear.” For the library personnel, such is not an excuse, saying that students should have the initiative to go the library and use the materials they that “they pay for.”

In such a context, there is a gap as to how to disseminate the information on the particulars of University A’s databases. But both set of actors—library personnel and students—point out to the function

Table 3. Expected User Population vs. Usage of Online and Serial Resources, (April 2005-March 2006)

	Expected User Population*			Online Usage**		Serial Usage	
	Undergrad	Grad	Total	Actual counts	Average use per student	Actual Counts	Average us per student
University A	18,040	3648	21,688	239,324	11.03	122,555	5.65
University B	53,007	7544***	60,551	96,453	1.59	25,108	0.41

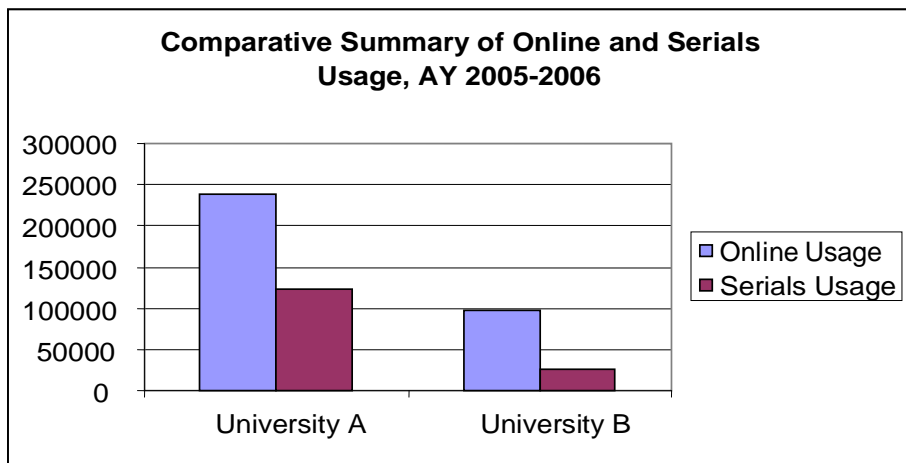
Source: University A Library, Office of the Registrar; University B Library, Office of the Registrar

* University A population includes the summer, first and second semesters of the academic year indicated. University B population includes only the first and second semesters.

** The counts of Online Usage are based on the accesses of *Academic Research Premier* that is included in the EBSCO host subscription.

*** Graduate students have their own separate library in their own division, therefore are not so much accessing the materials available in the library used by the undergraduates.

Table 4. Comparative Summary of Online Usage and Serial Usage, University A



of the teacher in order to bridge such information dissemination gap. University A thesis advisers recommend the online references, but the specific sources of these online materials varies. Some teachers recommend websites and search engines in the Internet, while others would direct their students to the online resources in the library.

Meanwhile University B thesis advisers seldom recommend online databases in the library because these are very limited and "almost useless" for the natural sciences. There are two scenarios emerging from the lack of journal resources in University B library. First, teachers do not at all know about the existence of EBSCO, *Millennium*, and *B-Project* in the library. Therefore, students of these thesis advisers would not be recommended to use the online databases in the library. But the library and the other thesis advisers (who know of the availability of the online databases) said the library has conducted several talks and seminars for the teachers to orient them of the online resources in the library.

In the second scenario, teachers know of the databases in the library, but they have not used it themselves, or have used it but rendered it not helpful for research. Teachers then recommend websites in the internet. The researchers send emails to the author of the journal, and hope that the author would send them a copy of the research. If this still does not work, then the thesis advisers would lead their students to other research institutes (i.e., National Library, International Rice Research Institute Library, Bureau of Fisheries, libraries of other universities).

Moreover, there is resource-sharing involved among the teachers. A University B thesis adviser who is unaware of the availability of databases said that none of her colleagues in the department has mentioned such library service, and that they are all relying on the same websites for researches. In other departments, on the other hand, where teachers are aware of online databases in the library, they recommend the use to one another, especially if they have used it before. Therefore, there is a social shaping involved: what their colleagues use, they also use.¹¹

Therefore for both universities, the teachers' lack of information on (a) what are the available materials in the library, (b) how to access and utilize the references in the library, and (c) what is the extent of relevance of the online materials in the library with regard to specific fields in the natural sciences, are all contributory to the social shaping of the utilization of the technology, which in effect, shapes and is shaped by their immediate epistemic community. What is lacking in the scenario is a mechanism of information dissemination from the library, among the teachers, going to the students. Such structure of information could change how the actors involved perceive the online materials, since such structure is a factor in the social shaping of the utilization of technology.

User Reluctance. Even in systems of knowledge production wherein the universities recommend the use of online journals (even if the journals did not come from the library), there are researchers who remain attached to conventional research methods (i.e., using printed materials). These

researchers find it difficult to adjust to the changes—both functional and substantive—that online technologies bring.

An illustration of this is seen in Table 5.

First, the teacher’s comment reveals that her only known way of accessing the internet is through going to the university library. Thus, it is not the cost that deters her from utilizing online materials for research, but the accessibility to the Internet. Second, her comment reveals her preference of printed journals and serials over online databases such as EBSCO, and that lack of awareness that one could easily print whatever journal has been researched in EBSCO.

Here it is seen how the teacher’s research methods deviate from what is assumed in Knorr Cetina’s (1981) concept of the scientist as a “practical reasoner” who would try to access as much new trends in acquiring scientific credit and capital. This key informant has a different definition of where the scientific capital could be found, such that her research is still based on more “traditional” methods (i.e., depending more on printed journals). This dependence on traditional methods is a result of the teacher’s reliance of what she was accustomed to

as a researcher (i.e., she has been using the printed journals throughout her years of studying, teaching, and researching), and adapting to the emerging research culture brought about by the availability of online technologies is something she does not find convenient.¹² However, it must be acknowledged that this reluctance to adapt to the changes in science and technologies limits the structures in epistemic community and in the production of knowledge as well. In this example, since the key informant is part of the Acquisitions Committee for the library, her preferences would push for the approval of printed journals over the requests for online materials. Hence, the degree of acceptance of the changes in science and technology is affected by the general attitude and priorities of the immediate epistemic community wherein one belongs. Such context is an example of what Pertierra (2003) says about how the rationalization of sociocultural structures has not forwarded the discourse that would incorporate the social changes brought about by the changes in science and technology.

The social shaping of technology involves structures that would make the utilization and formation of new technologies more conducive for the

Table 5. The Case of the Reluctant Teacher

<p>A key informant in University B, a Ph.D. graduate from a prestigious European university, has been a teacher for “a very long while”, and is highly regarded in the university in her area of study. She is also a member of the Library Acquisitions Committee which recommends the materials from the library’s list of books and subscriptions that would be added (or deducted) to online and serial references. She recommends that her students refer to journals in their thesis research, although what she recommends is that they find the journal entry in printed form.</p> <p>She said, “I do not always have the time to go to the library and go online, but when I have the study in paper, I have the convenience of having it just there in my files.”</p>

actors. However, in this study, the lack of information dissemination structures, and the interference of former structures (i.e., of time and age) hinder the growth of the knowledge production and epistemic communities.

EPISTEMIC COMMUNITIES: CREDIT AND CAPITAL

Through citation, referencing, and recommendations of relevant actors, students and thesis advisers locate themselves in the larger context of epistemic communities, and form their own structures and mechanisms of knowledge production. According to the students and teachers interviewed, they use published journals to adopt the research methodologies and “patterns of reasoning” in their respective studies. In this research, epistemic communities are analyzed through three parts – mechanisms of expanding and developing epistemic communities through the structures within the universities, inter-university epistemic community, and the acquisition of scientific capital in the larger epistemic community through referencing.

University Mechanisms for Expanding and Developing Epistemic Communities

Tables 6 and 7 summarize the structure by which universities expand their collection of references in order to provide for the demands of research materials in their libraries.

The structure in University A gives opportunities to address the reference needs of not only teachers, but also students. The structure rewards those who

accumulate more references, such that the library is willing to augment the budget of the department who has exceeded their original budget to acquire materials. The annual evaluation of funds also point out that the university puts primacy in research, such that the more references the departments buy and make their students use, the greater amount the university allots for their budget for acquisition for the following year. The university gives an extent of autonomy to its researchers to pursue knowledge production. Thus, the structure and mechanisms entail for the expansion of the epistemic community within the university to locate itself in the larger epistemic community.

In the case of University B, there is an inherent limitation in the structure, because the teachers in the departments and the library are mediated by the members of the Acquisitions Committee who are appointed by the Dean. The members of the Acquisitions Committee would inevitably have their own selectivity factors to prioritize, especially for requests for their department because new materials would widen the range of references for their area of research.

Moreover, since University B spends more on printed journals over subscriptions of online references, the range and extent of the materials for the natural sciences are limited according to very particular topics. Therefore, the topics that are covered by the printed materials are only those that are made available, compared to a possible vastness of journals that subscriptions to online materials could give. One teacher said that the university could at least get an account in some of the most frequently

Table 6 Summary of Reference Recommendation Procedure for University A*

Each academic department in University A has a certain budget for their acquisitions. Throughout the academic year, faculty members could forward their recommendations for books and journals (among other materials) that they need according to the subject and course curriculum. The allotted budget for each department is used to acquire the materials.

Moreover, students could also forward their own requests to the library, especially in terms of journals. The library would look for the references to provide for the student researchers for the meantime, and if they receive sufficient request for the same material, they would consider purchasing the reference to be included in the library.

There is a system of rewards given to the academic departments based on their acquisition. If a department has used more funds for their references, then the University allots a larger sum for them the following academic year. However, if the department is found to have not been effectively using the acquisition funds allotted to it, then its budget would be re-evaluated.

At points during the semester that the acquisition budget of the departments cannot pay for the reference requests, University A's library uses its own acquisition budget to purchase the reference materials recommended. The library's acquisition budget comes from various sources (i.e., as allocated from the over-all University budget, from the amount charged per student, and from donors if ever such amounts are given).

*As explained by University A library personnel

Table 7 Summary of Reference Recommendation Procedure for University B*

University B is divided into Schools, each home to different academic departments. The University has an Acquisitions Committee, to which each School is represented by one faculty member chosen by the Dean. The representative would gather recommendations from faculty members which he/she will forward to the Acquisitions Committee when it convenes.

The Committee and the library decide which reference recommendations would be approved, according to standards of affordability and being in line with the curriculum. This means that if the reference is necessary for the course and the subject area, then the library approves of it.

There are more printed references than online materials, such that the library selects to acquire printed ones rather than pay for subscriptions for the online websites and databases.

The library maintains a number of serials and printed journals in its selection, and cancellation of the subscription is placed under scrutiny. The Departments and the Schools must be "sure" that they want to cancel a subscription, because if the subscription is stopped and then later on resumed, then the result would be an incomplete collection.

*As explained by University B library personnel, and a thesis adviser who is a representative to the Acquisitions Committee

used website of journal databases that the teachers use, and the account could be shared by the departments and/or the university itself. However, the structure of prioritization of printed journals does not allow for the suggestion to happen, or at least not as of this time. Hence, the expansion of the epistemic community by means of a wider range of journals and researches to cite is not so much evident in University B, compared to University A.

Inter-University Epistemic Community

Table 8 summarizes the trend of accessing online resources, based on the tallies of searches of each university subscription from the EBSCO server. Based on table, the trend of accessing is almost the same for both universities. It peaks during the latter part of the first semester, and rises again at the latter part of the second semester in preparation for final requirements for different course loads. This shows the basic trend of research for the Philippine educational system, that at least once every semester, the students are required to conduct researches to contribute to the knowledge production.

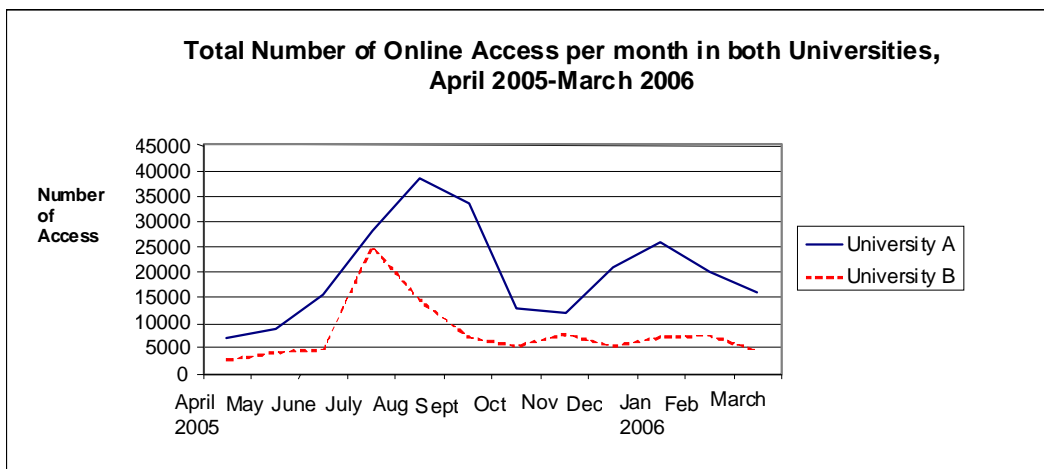
As earlier discussed, University B has limited serial and online resources. This limitedness is shown by the low counts of online access throughout the year (Table 8), because students and thesis advisers say that once the database shows that there are very few available sources for a particular topic, they would immediately go to other universities to find references. Thus, because some universities have more references than the others, resource sharing is done among Philippine universities.¹³ They allow

access to each others' collections, given proper recommendations are made. In cases that thesis advisers have to recommend a library to go to, where do they usually send their students?

University B thesis advisers, refer their students to University of the Philippines Los Baños campus or Diliman campus because the libraries of these campuses have a wider range of collections than the University B library. Here it is seen that the selectivity focuses more on the printed materials than the online materials. When asked why they do not send their students to University A, thesis advisers said that they are unaware that the University A library allows for visitor researchers. Whereas, University A library personnel said that it allows non-members of University A to use the references in the library for a minimal fee. Here it is seen that the relationship between the epistemic communities of University A and University B is not so much established, compared to the relationship and link of University B to University of the Philippines.

This means that the Philippine epistemic community is still putting a premium in utilizing printed journal collections in research, rather than referring to subscribing to websites that offer vast collections of references. Knowledge production has not adjusted to the changes brought about by technological advancements. Moreover, the Philippine epistemic community is nuanced to the societal conditions, as Pertierra (2003) says, that only some universities could afford such advancements in technology. Science and technology in the Philippines benefits those who have the capital (both financial

Table 8. Total Number of Online Access per month in both Universities, April 2005-March 2006



and scientific), which in turn produces more capital for them. In this case, the epistemic community in University A acquires the scientific capital through referencing to the most recent researches abroad, through its vast collection of updated databases.

SELECTIVE REFERENCING AND SCIENTIFIC CAPITAL

Knorr Cetina's concept of epistemic communities point out to the practice of citation and selective referencing as integrative mechanisms, which allows the scientist as a "practical reasoner" to situate himself in a larger epistemic communities. This assumes that the choice of referencing is placed under the selectivity of the researcher who wants to establish his place in the scientific community.¹⁴ However, the findings of this study regarding referencing of natural science researches in the Philippines would say that researchers do not have the discretion in "selective referencing." Instead,

Natural Science researchers in the epistemic communities of Philippine universities rely on whatever reference is available for their particular area of study. Therefore, the student and teacher researchers are limited according to what studies they could find that would be relevant to their research.

This is attributed to the lack of resources for the natural sciences here in the Philippines. Universities strive to acquire as much resources as possible, so that they would be able to provide for references to further the local epistemic communities. But this is nuanced to the economic factors that the Philippine universities have to deal with, such that very few institutions could afford resources such as University A, or a particular number of resources only such as University B.

However, even if referencing is limited, thesis advisers and students still use a number of criteria to select which

references they would be using for their research. This is the appropriation of the concept of “selective referencing” here in the Philippines. The following are the criteria that researchers in the natural sciences are using when utilizing printed journals:

- *Area of study for relevance.* This is the primary criterion given. Since researches in the natural sciences are very particular and focused, whatever resource for the topic would be deemed relevant.
- *Year of publication for significance.* The earlier the publication of the journal, the better. Some thesis advisers require journals published only as far as ten years prior to the present study (i.e., up to 1996 only if the thesis is done in 2006), while others require only from year 2000 onwards. This is to locating the studies in the most recent and developing epistemic communities.
- *Peer evaluation for credibility.* Researchers look at the website and see if the journals have been peer evaluated, meaning have been read and reviewed by other scientists as well.¹⁵ Peer evaluation could also mean that the journals (or websites) are recommended by their colleagues or their mentors.
- *Place of experimentation for research capacity.* Teachers and students say that they would find the sources credible if the researches had been conducted in Europe, America, and Japan, although they are not very much particular on the research institute or the authors. Therefore, much of the natural science researches here in the Philippines are referenced to the said larger epistemic communities abroad.

Hence, the concept of selective citation in Philippine natural science research deviates from the definition of selective citation by Knorr Cetina. Although, the assumptions remain that there are sources that are established in the epistemic communities abroad, which in turn would be used to build up scientific capital for the researches here in the Philippines.

If such criteria (i.e., significance) are used to determine which journals would be acceptable for study, then the continuous acquisition of printed materials would be put under question. For example, what happens to the printed journals when they are already considered outdated? They cannot be disposed, both Universities agree, but must be stored in case the journals would be needed in the future. For University A, such problem is answered by the movement towards acquiring and maintaining online databases. In the case of the printed collections, University A is “microfilming” the journals and store them in CDs, so that the studies would still be kept. On the other hand, University B is not concerned of such as of now, and has not finalized if its library would expand its collection of online databases because of the costs entailed. All of these concerns would have to be addressed in the near future not just by the two universities under study, but all the universities in the Philippines that acquire reference materials.

Epistemic communities here in the Philippines are nuanced to the structures within Universities, the referencing practiced by teachers, and the limitations set by the capacity of Universities to acquire and share resources. Thus, Knorr

Cetina's (1981) selective referencing does not readily apply, at least to the natural sciences, since researchers in the Philippines are bound to the socio-cultural and economic considerations in the acquisition of online materials.

CONCLUSION AND IMPLICATIONS

Epistemic communities in the undergraduate natural sciences programs in the Philippines are challenged by the constant innovations in science and technology. These innovations have implications to access to journals and researches that situate the country's researchers in the more established research communities abroad. In such case, the scientist as a "practical and economic reasoner" plays a very important role in making the epistemic communities in the Philippines more established, and in creating a balance between scientific credit and capital with the economic limitations. The values that inform the decisions of these "scientists" in knowledge production must be clear: should research communities in the Philippines value research capacity and independence, or should they primarily consider costs and expenses acquired in the process of purchasing references? Such contingency is not in a binary opposition, since it is already established that resource-sharing is possible. However, even this resource-sharing is still adapting to the emerging online technologies, and would require more time for the epistemic community encompassing all the knowledge producers in the Philippines to be able to maximize the benefits of the online databases to researching.

Moreover, this study shows that the knowledge producers in the natural sciences in the Philippines possess less capacity to determine the course of their research, at the very start in the theoretical framing stage because of the limitedness of the references in the country. This is because selective referencing in the Philippines is limited to the availability of references, nuanced to the economic capacity, and factors of selectivity considered by agencies of knowledge production. This is slightly different from Knorr Cetina's (1981) assumption that the scientist has the prerogative to choose references in established epistemic communities.

This research is the first study ever conducted that evaluates knowledge production in Philippine universities with regard to online technologies. This could be furthered in a few years' time to reassess how technologies are utilized to further research – whether or not online databases in universities are more utilized, whether or not the problem of physical space has been addressed, whether or not teachers and students are more comfortable in using online technologies, whether or not resource sharing among Philippine universities have significantly changed. This study could also be forwarded if expanded to examine the use of technologies in social science researches.

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NOTES

- 1 This focus takes into account that researches for the social sciences have a much wider scope of available references. Online journals such as EBSCO and JSTOR contain researches from almost all areas of research, not only in the social sciences. Moreover, other fields of study in the social sciences also tap into current events and updated statistics, and such data do not come from the journals made available by the online databases.
- 2 The names of the universities are kept confidential, since there are data and information in this study that have been granted permission only for research purposes.
- 3 CIPPA, a program shared by some Philippine universities, compiles and microfilms local publications for archiving and retrieval. It is a project started by and purchased from Ateneo de Manila University.
- 4 *Millennium* is the real name of the university software.
- 5 *B-Project* is a pseudonym for the actual project that has been launched by University B.
- 6 According to library personnel, the costing as given by the host server (i.e., EBSCO) differs according to the number of projected users in the university subscribing to it, among many other considerations. This means that the costs could lower as the number of potential users increase.
- 7 If a needed journal is not available in University A library, University A would contact the other universities in the Philippines that provide online databases to check for the availability of the needed study. The researcher would then have to pay for fax services. However, since University A provides the largest collection of online databases in the country, this scenario does not always happen.
- 8 This supports the interview findings that students and teachers prefer doing research in the library, at least initially, and would continue to access online journals for as long as they could find the resources that are applicable to their area and topic of research.
- 9 This observation is based on computing the total amount spent on acquiring online materials divided by the total number of accesses. Therefore, more number of accesses, the lesser amount is spent per access.

- 10 *Scholar.google.com* is a search engine powered by Google.com that looks for journals, theses, and dissertations that are available in the internet. It might be considered a competition for the online databases that have to be purchased by universities, but University A library personnel say that the collections in *scholar.google.com* are “less vast and less credible” than those in the purchased online databases. A key informant who works in the library said that EBSCO reviews which journals it would include in its roster of titles and would offer the most useful ones. However, students who have been using *scholar.google.com* disagree, saying that those in the library “could be” more limited than the internet.
- 11 The consensus of what the teachers use determines their epistemic community and locates their epistemic community to a larger one – that wherein the studies they download are part of.
- 12 Before, internet resources were not yet available, and she takes this scenario as the “convenient” one. Selectivity could be at work when she reasons that since it worked during her time, then it should work in this time, ignoring the influence of the development of online technologies and its effects in research.
- 13 It has been explained at the earlier section of the findings that University B is maintaining the chemical abstracts based on its agreement with the Department of Science and Technology, while University A gathers as much resources as they could which gives it an extent of research independence.
- 14 For example, researchers would have a particular author or school of thought in mind, and that they would connect themselves to this author through citations so that they could be integrated in the author’s epistemic community.
- 15 This is not particularly a concern because journals would have to be peer-evaluated before they could be published. This criterion applies more on the researches that are searched and retrieved through the internet.

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