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THE RECIPROCAL DETERMINISM OF ONLINE SCAFFOLDING IN SUSTAINING A COMMUNITY OF INQUIRY IN PHYSICS

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Abstract

This study investigated the learning impact of online scaffolding in sustaining a community of inquiry in Physics instruction. The students' a-priori e-learning activities in online discussion were used in leveraging the learning behaviors of the students. Online learning segments were included in the process of developing classroom tasks vis-à-vis with the course intended learning outcomes. This was done in a collegial, constructive and democratic learning towards classroom efficacy through online scaffolding techniques. Two sections of 34 students enrolled in NATSC1D (University Physics 1) were used in this study. A questionnaire was adopted in determining the perceived relative magnitude of advantages of the online discussion. Pearson-r correlation results showed a very-highly positive correlation between the students' a-priori e-learning experiences in online discussion and their success in online scaffolding, and a highly to very-highly positive correlation to their performance in classroom interaction, formative assessment and summative evaluations.

Keywords – A-priori e-learning experiences, Asynchronous and synchronous e-learning modality, Community of inquiry, Online scaffolding, Reciprocal determinism and causation

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1 INTRODUCTION

The advent of advanced educational technologies is a vast array of digital resources and content in learning that offers the magnanimity of theories towards educational opportunities. This offers practices in sustaining a community of inquiry in a dynamic classroom.

Sustaining a community of inquiry in any educative instruction requires greater options for quantity and quality of learning interactions in a collegial learning environment. This offers the student-learners the opportunity to interact with each other at anytime and anywhere through online discussion tools and facilities. One of the approaches in the sustenance of this community of inquiry is the implementation of the online scaffolding in classroom instruction.

Online scaffolding creates a technology-based instruction as a way of enriching the educative processes to be more integrative through synchronous and asynchronous learning modalities. It restructures the traditional classroom routines with online learning.

Reciprocal causation is based on the reciprocal determinism theory (Bandura, 1986) that holds the idea that learning behaviors are controlled by cognitive processes. Cognition transforms the individual through imitation, modeling and feedback consists of environmental, individual and other social stimulus that are believed to reshape the learning environment of the student-learner. Cognitive apprenticeship (Brown, et al., 1989) in Anderson (2006) is a form of learning based on collaborative social interaction and social construction of

knowledge by enabling the students to acquire and develop cognition as they get involved in a community of practice in a "legitimate peripheral participation".

Astutely, the influence of Bandura's Social Learning Theory – the notion that most human behavior is learned by observation and in turn codes information that serves as a model for action, appears evident in an online segment of learning (Ryan-Rojas, Douglass & Ryan, 2012). It is postulated that a person's behavior is influenced by the environment and vice versa, so with learning. Behavior and actions, together with cognition, are causations of past events and experiences.

Researches on the introduction of online scaffolding and segments of instructional techniques had been prevalent over the decade and yielded positive findings: an enriching leap towards harnessing communication abilities among student-learners, open and free discussion boards through various modalities of inquiry and deconstruction process that harmonize theories of interaction and discourses in teaching-and-learning. These researches had established positive impact on the academic performance and achievement of the student-learners towards learning outcomes.

Online learning happens in a community of inquiry in a self-regulated constructive learning environment. Learners interact with varied learning modalities of synchronous and asynchronous activities of rich learning environment. This environment allows cooperative attainment of the learning contents' objectives and the development of personal relationship among the student-learner participants. (Anderson & Elloumi, 2004).

Mediated with online scaffolding of instructional delivery, the teacher and learners work together to optimize learning experiences. This provides realistic yet practical opportunities in attaining sustainability in the teaching-learning process through independent and constructive learning. This is necessary as the nature and purposes of Physics instruction needs reinforcement for it had been mystified as difficult since time inmemorial. Most students hold negative stereotype images of science and technology in general and Physics in particular.

The crux is: science instruction needs to be re-energized by providing challenging units of inquiry among its student-learners – the creation of intuitive learning engages student-learners from the spark of excitement that stems from discovery. This engagement results in more learning as they develop more integrated, useful understanding of concepts and their interrelationships and applicability (Beatly, 2004 and Tytler, 2007 in Bautista, 2012).

1.1 The Online Learning Model

The Online Learning Model developed by Anderson & Elloumi presents the theories and practices of online learning in an academic setting. It presents the two main actors of the educative processes, the teacher and the student-learners, interacting in a constructive learning environment of different modalities – synchronous and asynchronous. It further presents the difference between independent and paced collaborative learning modalities.

Asynchronous e-learning modality refers to a student-centered strategy based on constructivist that gives emphasis on peer-to-peer interaction in online learning resources, i.e., LMS, online mentoring, chat room/bulletin group discussion and e-mail exchange. Learning Management System (LMS), which is also known as Course Management System (CMS), hosts online instructional designs and technique in an online platform.

On the other hand, approaches of lesson development that requires the interaction of the student-learner and professors in an online platform are said to be synchronous e-learning. Developmental activities like thread discussion and presentations are done at a specific hour in order for the student-learners to participate and graded. Platforms may include LMS, online mentoring, chat room/bulletin group discussion.

In independent learning modality, learning happens in a sequenced and directed or structured learning environment putting the content as the heart of the process. The teacher controls the content where the student-learner interacts.

On the contrary, learning happens in a community of inquiry in a self-paced cooperative learning. Learners interact with varied learning modalities of synchronous and asynchronous activities of rich learning environment. This environment allows cooperative attainment of the learning contents' objectives and the development of personal relationship among the student-learner participants.

Examples of the synergy developed in these sequences, but not limited to the following, pave for more success towards the students' tasks towards independent learning: creativity through association, drill and exercises,

behaviors through simulation, feedback and practice, sound judgment from received feedbacks and coaching among their peers, analysis, deconstruction and practice to both synchronous and asynchronous learning activities.

Astutely, learning is made meaningful and interactive. It leverages higher-learning that involves cognitive and metacognitive learning strategies. Social presence is cognizant to the development of personal meaning – the development of new cognitive and metacognitive knowledge, skills and attitudes as the student-learners interact with the focal point of the inquiry in a constructive learning environment. This cognition is critical to the creation of a sagacious sense of presence that sustains a community of inquiry among the online learners, thus promotes transformational learning (Murphy and Cifuentes, 2001) in Anderson and Elloumi (2004).

1.2 The Social Learning Theory

Bandura's Social Learning Theory presents the interrelationship of observation and modeling of behaviors, attitudes, and emotional reactions of others in the learning process of an individual learner. The theory posits that human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action."

Social Learning Theory (SLT) is also influenced by reciprocal causation: the person, behavior and environment are influencing each other through self-efficacy and self-regulation. Learning employs self-confidence towards learning (self-efficacy) under circumstances of an individual's personal ideas on the appropriateness and inappropriateness of actions in improving his own behaviors (self-regulation). Self-regulation involves modeling (doing what others do both live model and symbolic models) and imitation (using another learner's behavior as a discriminating stimulus both vicarious reinforcement and vicarious punishment). Therefore, SLT spans to both cognitive and behavioral frameworks by encompassing attention, memory and motivation. Hence, the central role of social learning is on behavioral interpretation of modeling. These leaps are link to the Social Development (Vygotsky) and Situated Learning (Lave) Theories.

Social Development Theory posits that the social interactions made by a student-learner precede development, consciousness and cognition. Hypothesizing that cognition and development are the end product of socialization and social behaviors, the theory posits the following tenets: (1) Social interaction plays a fundamental role in the process of cognitive development. Vygotsky felt social learning precedes development. He states: "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological);" (2) The More Knowledgeable Other (MKO). The MKO refers to anyone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. The MKO is normally thought of as being a teacher, coach, or older adult, but the MKO could also be peers, a younger person, or even computers. (3) The Zone of Proximal Development (ZPD). The ZPD is the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability on solving the problem independently. According to Vygotsky, learning occurred in this zone. (Vigotsky, 1978 as cited in http://www.learning-theories.com/vygotskys-social-learning-theory.html).

Situated Learning Theory argues that learning is a function of various activities, contexts and culture of inquiry under social interactions in a process of "legitimate peripheral participation. Social interaction is a critical component of situated learning. Student-learners are invited to come across learning in a "community of practice" which embodies certain beliefs and behaviors to be observed and practiced. As student-learners involve themselves in the process of cognitive inquiry, they become more active and engaged within each interaction. Hence, the student-learners assume roles in the learning environment which is usually unintentional rather than deliberate. (Lave, 1988 as cited in http://www.learning-theories.com/situated-learning-theory-lave.html).

1.3 Objectives Of The Study

This study was designed to determine the learning impact of online scaffolding in the sustenance of a community of inquiry in Physics instruction.

Specifically, it attempted to provide explanations of the following:

- What are the a-priori learning experiences of the student-learners in synchronous and asynchronous online scaffolding?

- Is there a significant relationship between the students' a priori experiences and the characteristics of their success in online scaffolding of teaching and learning?
- What is the impact of the online scaffolding on the students' success in achieving the course' learning outcomes?
- How do the student-learners perceive the relative magnitude of advantages of the online scaffolding of teaching and learning?

2 DESIGN/METHODOLOGY/APPROACH

The Descriptive-Correlational Research Design was used in this study. The results provided bases in the establishment of the relationship between the independent variables and dependent variables of the study. It elucidated on the impact of the embedded online instructional segment to the students' success in achieving select course intended learning outcomes through modalities of online scaffolding. The online instructional segments used in this study were LMS, online mentoring, chat room/bulletin group discussion and e-mail exchange; all were done in the e-learning facility of the university, together with the personal e-mail of the researcher. This study was conducted at the Natural Science Department of the Center for General Education, during the second trimester, SY 2012 – 2013. The respondents of this study were the 2 sections of NATSC1D (University Physics 1) handled by the proponent. The frequency counts, mean and Pearson-r correlation were used in the treatment of the data gathered to conclude on the stated problems of the study.

A questionnaire formulated by Anderson and Elloumi (2004) was adopted to determine the learning impact of the embedded online segments and experiences through online platforms to the learning experiences of students.

Students' academic performance towards the course was determined by their performance in one of the major examinations (Midterm Examination). The test instrument was formulated based on a two-way Table of Specification and assessed through the internal moderation used by the university. The instrument was validated by the course coordinator, together with other teachers teaching the subject, and the department head of Natural Sciences.

Figure 1 presents the variables expected to sustain a community of inquiry in Physics instruction. It includes the students' a-priori online learning experiences, the reciprocal causation of the learning environment and the e-learning modalities to be implemented in the instructional design of the class program – synchronous and asynchronous. The students' a-priori experiences in online platforms are believed to be their encapsulating schema towards their success in their online classwork.

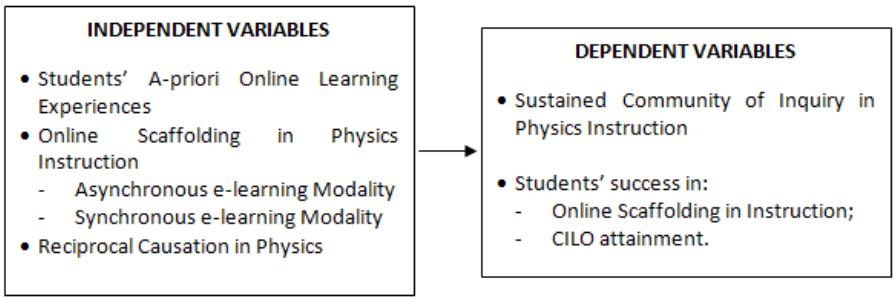

Figure 1. Research Paradigm

The reciprocal causation was employed to qualify interaction between and among the actors and actresses of the classroom instruction – the teacher and the learner. It employed the reciprocal determinism theory relative to the analysis of the effects of online scaffolding in classroom interaction.

The modalities of classroom instruction offered in a constructive learning environment were synchronous and asynchronous. The Social Learning Theory of Bandura, together with Social Development (Vygotsky) and Situated Learning (Lave) Theories, was the recuperating basis in regulating the pace of the instructional design of the class program.

These leaps are expected to reshape the Physics instruction in the sustenance of the classroom's community of inquiry.

3 RESULTS AND DISCUSSION

Table 1 presents the a-priori learning experiences of the student-learners in synchronous and asynchronous online learning activities. As gleaned on the table, the respondents are exposed to online platforms and other social networking sites with a composite mean of 3.64 and interpreted as *often*. However, it can be noted that the students *seldom* (*mean* = 3.32) use social and communications tools, like online dating, friends reunited, among others, due to the respondents' cultural endowment and restrictions.

		Mean	***Descriptive Interpretation***
1.	*I am a social butterfly and use social networks (E.g. MySpace, Flicker, Facebook, among others)*	*3.79*	*Often*
2.	*I use synchronous chat tools (E.g. Instant messaging, chat rooms, IP telephony, among others)*	*3.56*	*Often*
3.	*I use messaging and discussion tools (E.g. Email, forums, phone texting like BBM, Tango)*	*3.88*	*Often*
4.	*I play online games or use virtual worlds and talk to other players (E.g. World of War Craft, Battlefront 2, Sims Online, Second Life)*	*3.71*	*Often*
5.	*I have an online personal space other than a social network (E.g. Web pages, blogs, triond team, among others)*	*3.56*	*Often*
6.	*I use other social and communication tools online (E.g. Online dating, Friends Reunited, among others)*	*3.32*	*Seldom*
Composite Mean		*3.64*	*Often*

Table 1. The A-priori Learning Experiences of the Student-learners in Synchronous and Asynchronous Online Learning Activities

It can be construed then that the students had rich e-learning experiences and were social butterflies in leading social network that employ online discussion. In an interview with the respondents, they admitted that they often join online discussion as they could freely express themselves without any reservation of being wrong. Some of the respondents revealed that they were just observers and do not participate in the discussion. However, they revealed that they learn in the threads of discussion. This phenomenon is supported by Bandura (1986) in his Social Learning Theory.It posits that learning cognition, which is based on cognitive processes, transforms the individual through imitation, modeling and feedback consists of environmental, individual and other social stimulus that are believed to reshape the learning environment of the student-learner.

Table 2 presents the relationship between the students' a-priori learning experiences and the characteristics of their success in online discussion. It presents that their a-priori learning activities that include online chat, virtual world, among others, made them succeed in the online discussions conducted. It can be said that the students who were exposed to online discussion portals were the students who were receptive and participative to the e-learning activities conducted. The test results show that there is a highly significant relationship between the two variables: *r-value* of .842 and a *p-value* of < .001 at .01 level of significance. Hence, the null hypothesis of no significance difference between the students' a-priori learning experiences and their success' characteristics in online discussion is hereby rejected.

		Participation and Success to Online Discussion
A-priori e-learning experiences of the student-learners	*Pearson Correlation*	*.842***
	Sig. (2-tailed)	*.000*
	N	*34*

***. Correlation is significant at the 0.01 level (2-tailed).*

Table 2. The Relationship between the Students' A-priori Experiences and the Characteristics of their Success in Online Discussion

This result is similar to the findings of Anderson (2006), Anderson and Elloumi (2004), Bautista (2012) and Ryan-Rojas, et al (2012) in their studies on online delivery techniques of instruction. They concluded that the learning behaviors of the students in online discussion are controlled by their computer playfulness and online cognition.

Independent Variables		***Dependent Variables Performance to***		
		Class Participation	***Formative Assessment***	***Summative Evaluation***
Exposure to Online Discussion in Educational Sites/ Social Networks	*Pearson Correlation*	*.993***	*.699***	*.686***
	Sig. (2-tailed)	*.000*	*.000*	*.000*
	N	*34*	*34*	*34*
Participation to Online Discussion	*Pearson Correlation*	*.695***	*.586***	*.581***
	Sig. (2-tailed)	*.000*	*.000*	*.000*
	N	*34*	*34*	*34*
E-mail Exchange	*Pearson Correlation*	*.505***	*.417**	*.386**
	Sig. (2-tailed)	*.002*	*.014*	*.024*
	N	*34*	*34*	*34*

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

Table 3. The Impact of the Online Scaffolding on the Students' Success in Achieving the Course' Learning Outcomes

Presented in the foregoing table is the learning impact of online scaffolding to their performances to class participation, formative assessment and summative evaluations.

It presents that the indicators of the online scaffolding techniques done honed their performances in the class as indicated by the *r-values* and the *p-values* at .05 and .01 levels of significance. Results showed a highly to very highly significant positive correlations. Hence, the null hypothesis of no significant impact on the success of achieving select course intended learning outcomes in Physics is hereby rejected.

These findings post similar results of Anderson (2006), Anderson and Elloumi (2004), Aguado, Barrutia & Echebarria (2012), Bautista (2012), Langenhorst (2012) and Ryan-Rojas, et al (2012) in their studies on online delivery technique. The involvement of leveraging and harnessing students' prior e-learning experiences in integrating new ideas and information in constructing a body of knowledge cognizant to enhancing the over-all students learning in a collegial, constructive and democratic learning environment were categorically articulated.

On the other hand, the interaction models of online Learning of Anderson and Elloumi (2004) and the time and place dimensions of online delivery systems of Duderstadt (1997) in O'Malley & McCraw (2000) can be posited as bases of this cognition process where learning takes place in a community of inquiry. Knowing that learners learn in varied modalities of creativity, deconstruction and sound judgment to feedback on the threads of discussions during on-line scaffolding sustains a community of inquiry among students. Hence, learning is enforced as continuous research and investigation are to be done.

Table 4 presents the perceived satisfaction of the student-learners to the online scaffolding in their learning activities in Physics. It can be gleaned on the table that the student-learners' were *satisfied* (*Composite Mean* = 3.68) with their various learning activities.

These behaviors towards online learning were the results of direct to indirect discussion that leads to mental cognition and learning behaviors. Cognition is believed to reshape the learning environment of the student-learner by transforming the individual's learning schema through imitation, modeling and feedback consists of environmental, individual and other social stimulus. Learning in this condition is based on collaborative social interaction and social construction of knowledge by enabling the students to acquire and develop cognition as they get involved in a community of practice in a "legitimate peripheral participation" (Brown, et al., 1989) in Anderson (2006).

The notion of interaction must become the integral concept of both learning and computer mediation in classroom instruction. Interaction refers to reciprocal events involving at least two actors and/or objects and at

least two actions in which the actors, objects, and events mutually influence each other. Hence, verbal immediacy behavior is still the central concept of reciprocal events and mutual response if an online platform is to enhance communication skills among students in fostering active participation (Shea, Swan, Fredericksen & Pickett, 2002; Swan, 2003; Schiederig, 2007).

		Mean	***Descriptive Interpretation***
1.	*I am free to participate in the discussion more frequently than traditional courses.*	*3.74*	*Satisfied*
2.	*It enables me to take more researches than the traditional classroom routine.*	*3.62*	*Satisfied*
3.	*It develops my critical thinking abilities more than the traditional classroom routine.*	*3.91*	*Satisfied*
4.	*I am satisfied on the use of online platforms.*	*3.53*	*Satisfied*
5.	*I would like to have more courses usingonline platforms.*	*3.62*	*Satisfied*
Composite Mean		*3.68*	*Satisfied*

Table 4.The Perceived Satisfaction of Online Scaffolding in the Students' Learning Activities

Concomitantly, the teacher still plays an important role as the teacher's feedback and interaction is still essential to facilitate learning since students are vulnerable to generate significant ideas. Hence, teachers must be flexible enough in the switch response categories in the analysis of problem, proposition, statement, among others (Sloan Consortium, 2002; Anderson, 2006; Laverty, Wood, Tannehill, Kohun & Turchek, 2012).

The integration of online platforms in classroom instruction paved favorable avenues in meeting the demands of the digitals years of academic institutions. Benefits are reasonably keystones in the progression of collaborative social interaction and social construction of knowledge in sustaining a community of inquiry in Physics instruction. It must pave avenues for divergent and reflective independent learning skills.

Table 5 presents the general perception of the respondents on the benefits of online scaffolding to their learning tasks in sustaining a community of inquiry beyond classroom hours. It presents that the students had a general perception of *3.76* and interpreted as *advantageous*. These results could validate findings and analysis of online segments on educational technologies whether or not students develop esteem the ability to articulate and replicate their insights through reflective thinking and reasoning at their own pace, and the progression of background knowledge in a dialogical learning environment (Bautista, 2012). While learning in online segments occurs socially within the vicarious interaction of the learning platform, students' learning is attributed to the number and superiority of inquiry supportive of divergent thinking, exploration and reflection (Swan, 2003). Hence, the teacher, as facilitator of student learning, plays a critical role in order to reap and reduce the drawbacks of the contrasting learning modes of student-learners in an online platform.

		Mean	***Descriptive Interpretation***
1.	*Online scaffolding enables me to participate in the discussion more frequently than traditional courses.*	*3.68*	*Advantageous*
2.	*Online scaffolding enables me to take more researches than the traditional classroom routine.*	*3.91*	*Advantageous*
3.	*Online scaffolding develops my critical thinking abilities more than the traditional classroom routine.*	*3.59*	*Advantageous*
4.	*I benefit in online scaffolding technique.*	*3.71*	*Advantageous*
5.	*I would like to have more courses taught using online scaffolding technique.*	*3.91*	*Advantageous*
Composite Mean		*3.76*	*Advantageous*

Table 5. The Perceived Magnitude of Advantages of the Online Scaffolding of Teaching and Learning

4 CONCLUSIONS

Based on the findings of the study, the following are concluded: (1) The student-learners had rich a-priori e-learning experiences in the virtual world and online discussion portals; (2) The students' a-priori e-learning experiences was a highly positively correlated with characteristics of their success in online scaffolding; (3)

Online scaffolding techniques were positively correlated to the performance of students in achieving select learning outcomes in Physics; (4) The students were satisfied to the learning experiences they got in online scaffolding; and (5) The students had an advantageous perception on the benefits of online scaffolding.

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