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ISSN 1939-5256 (print)
ISSN 1092-8235 (online)

Journal of Asynchronous Learning Networks

JALN

Volume 12, Issue 3/4 - December 2008

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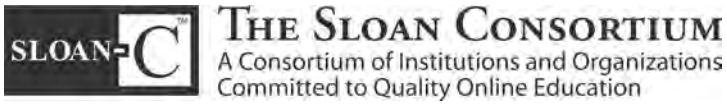

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Cover design by Leighton Ige.

Printed in the United States of America

0 9 8 7 6 5 4 3 2 1

International Standard Serial Number 1939-5256 (print)

International Standard Serial Number 1092-8235 (online)

Journal of Asynchronous Learning Networks

Volume 12 Issue 3/4 December 2008

This book was made possible by a grant from the Alfred P. Sloan Foundation.

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THE DEVELOPMENT OF A COMMUNITY OF INQUIRY OVER TIME IN AN ONLINE COURSE: UNDERSTANDING THE PROGRESSION AND INTEGRATION OF SOCIAL, COGNITIVE AND TEACHING PRESENCE

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ABSTRACT

The purpose of this study was to explore the dynamics of an online educational experience through the lens of the Community of Inquiry framework. Transcript analysis of online discussion postings and the Community of Inquiry survey were applied to understand the progression and integration of each of the Community of Inquiry presences. The results indicated significant change in teaching and social presence categories over time. Moreover, survey results yielded significant relationships among teaching presence, cognitive presence and social presence, and students' perceived learning and satisfaction in the course. The findings have important implications theoretically in terms of confirming the framework and practically by identifying the dynamics of each of the presences and their association with perceived learning and satisfaction.

KEYWORDS

Online Learning; Community of Inquiry; Social Presence; Cognitive Presence; Teaching Presence; Group Identity; CoI Survey; Negotiated Coding; Perceived Learning; Satisfaction

I. INTRODUCTION

It has long been recognized that meaningful and worthwhile learning is associated with collaborative communities of inquiry [1, 2, 3]. While communities of inquiry have been the ideal in higher education, little was known about the properties of an online learning environment and how online learning communities could be constituted. Of particular interest and challenge was how to create and sustain a community of learners in an online learning environment. The focus of this research is to explore the developmental nature of an online community of inquiry. More specifically, the focus is on using the Community of Inquiry framework [4] to study the dynamics of a community of learners over a course of study. We report on the progressive and developmental nature of each of the constituting elements of this framework (social, cognitive and teaching presence). In addition, the relationships among the three elements and perceived learning and satisfaction are explored.

II. THEORETICAL BACKGROUND

While there has been an explosion of research on online learning, much of this research has been atheoretical and fragmented [5, 6]. Many authors call for the need for development and refinement of theories to better understand learning and teaching in online environments [7, 8, 9]. One approach to online learning research that has gained some attention for its theoretical and methodological approach is that of Garrison, Anderson and Archer [4, 5]. The Community of Inquiry framework identified the key elements of an educational transaction that could be studied in concert such that their interdependencies could be understood. This framework is not a static model but attempts to explain the educational experience from a process perspective. As such, there is a strong need to study the dynamics of its constituting elements. One of the over-riding issues identified in a review of the research associated with this framework is understanding its dynamic nature [5]. The developmental issues associated with the Community of Inquiry framework have enormous theoretical and practical implications.

The Community of Inquiry (CoI) framework is formed by the intersection of three main elements—social presence, cognitive presence and teaching presence [4]. It has been shown to be a useful theoretical framework and tool to study and design online learning experiences [5]. All the presences were defined as multi-dimensional elements. Each of the presences is operationally defined in terms of the constituting categories (see Figure 1). Social presence was defined in terms of affective expression, open communication and group cohesion. Cognitive presence was defined by the practical inquiry model and consisted of the phases—triggering event, exploration, integration, and resolution. Teaching presence was defined in terms of design, facilitation and direct instruction. It should also be noted that correlations have been found between perceived learning and student satisfaction and each of the presences of the CoI [5, 10].

ELEMENTS	CATEGORIES	INDICATORS (examples only)
Social Presence	Open Communication	Learning Climate/Risk-Free Expression
	Group Cohesion	Group Identity/Collaboration
	Personal/Affective	Self Projection/Expressing Emotions
Cognitive Presence	Triggering Event	Sense of Puzzlement
	Exploration	Information Exchange
	Integration	Connecting Ideas
	Resolution	Applying New Ideas
Teaching Presence	Design & Organization	Setting Curriculum & Methods
	Facilitating Discourse	Shaping Constructive Exchange
	Direct Instruction	Focusing and Resolving Issues

Figure 1: Operational Definitions of the Presences

With the possible exception of cognitive presence, the internal dynamics of each of the presences has not been explicitly addressed. In terms of cognitive presence, the early research did focus on moving students through the phases of inquiry. In this regard it was noted that considerable teaching presence, including a well designed task with the expectation of a resolution, was required to move students through the phases. Teaching presence did imply a logical progression from design to facilitation and direct instruction when

required. The dynamic nature of social presence, however, was not quite so clear. The accepted doctrine was to focus on affective expression to establish a climate for learning with open communication and cohesion following. Recent speculation is that this may be more complex than originally conceived. Rogers and Lea [11] suggest that it is shared social identity with the group and not personal identity that is crucial for cohesive group behavior. As such, in a purposeful educational community, participants identify first with the course of study and personal relations follow from the goals of an educational experience.

If the intended result of social presence is to confer on the group greater capacity to communicate and collaborate, then the group will work more productively to the extent that group members identify with the group… [11, p. 153].

That is, open communication and cohesion are based on identifying with the group and the interests of the course. The implication is, therefore, that personal identity and relationships should be allowed to develop naturally and should not be forced on participants as the first order of business [12].

In addition to the internal dynamics of each of the presences, little is known about the relative developmental progression of each of the presences as a whole. For example, what is the relationship between teaching presence and cognitive presence as students progress through their course of studies? Similarly, what is the relationship between social presence and cognitive presence as students move through the phases of inquiry? And finally, what effect does each of the presences have on perceived learning and satisfaction? The literature review conducted by the authors did not yield much research that investigated how the Community of Inquiry framework changed over time in a specific context. However, one recent study examined cognitive presence over time by comparing the differences between two chat postings [13]. In short, the findings showed that exploratory statements increased over time indicating greater sharing of personal experience and previous knowledge. This study expanded the scope by focusing on all three elements of the CoI framework over a nine week period.

III. METHODOLOGY

A graduate course with 16 students given in the fall term of 2007 at University of Calgary was the focus of this study. The topic of the course was blended learning and the CoI framework provided the organizational structure for the course. The course was delivered fully online using asynchronous and synchronous formats (i.e., Blackboard and Elluminate). To increase accessibility to the course instructor, virtual office hours through Elluminate were also applied regularly. In the first Elluminate meeting, all students were welcomed, and the course, objectives, assignments, students' responsibilities and assessment strategies were introduced. Students were also asked to identify questions about course content and process.

Learning activities, strategies and assessment techniques were all developed to embed and reflect all three elements of the framework. The major assignments were article critiques and peer reviews, weekly online discussions and course redesign prototype projects. In the first online discussion, the instructor modeled how to facilitate the discussion in an effective way. To distribute teaching presence among students and teacher, in each of the remaining weeks students were responsible to moderate and facilitate the online discussions. This was the main reason that instructor postings were excluded in the transcript analysis. Garrison and Anderson [6] emphasize distribution of teaching presence also for the reason that student moderation can also attenuate the authoritative influence of a teacher and encourage freer discussion. The

final assignment was a course redesign project where students incorporated understandings from the discussions.

The complex nature of online learning calls for the use of multiple methods and multiple sources of data to understand group as well as individual learning [14]. Therefore, this study applied a mixed methodology approach which provides depth and breadth to the study not possible using either quantitative or qualitative data exclusively [15, 16]. With an eclectic approach, mixed method research is inclusive, pluralistic and complementary [17]. Moreover, collecting multiple data and using different strategies, approaches, and methods may increase the validity and reliability by eliminating limitations of each single method and complementing one another [16, 17, 18].

Transcript analysis was used to investigate how elements of the community of inquiry changes over time. Transcript analysis used here is a research technique for making replicable and valid inferences from data to their context [19]. Consistent with the research methodology, both manifest and latent content analysis strategies were applied to code and explore posting patterns of social presence, teaching presence and cognitive presence. The researchers coded each message based on category indicators defined in the CoI framework as well as the meaning of that message in the context of discussion. The first author and a research assistant analyzed the transcripts by applying a negotiated coding approach [20]. (The rationale behind the use of negotiated coding in an exploratory qualitative transcript analysis can be found in Garrison, et al. [20].) The researchers coded two discussion transcripts of a previous online course to get experience and gain familiarity with the process. The inter-rater reliability of the first training session for coding the transcripts was .75. This provided an estimate of reliability between the coders, notwithstanding the adoption and advantage of a negotiated coding approach. In the negotiated approach, the researchers coded transcripts and then actively discussed their respective codes to arrive at a final assessment of the code. Negotiation provided a means for on-going training, refining the coding scheme, controlling for simple errors, and thereby, increasing reliability.

A CoI survey instrument was also administered at the end of the class to assess the relationships among the three CoI presences and student perceived learning and satisfaction. The instrument was developed and validated by Ice and colleagues [21]. Cronbach's Alpha was 0.94 for teaching presence, 0.91 for social presence, and 0.95 for cognitive presence. The Community of Inquiry (CoI) survey included teaching presence perception (13 items), social presence perception (9 items), cognitive presence perception (12 items), one item for perceived learning, and one item for perceived satisfaction. The items were measured on a 5-point Likert-type scale with 1=Strongly Disagree and 5=Strongly Agree. Fifteen students (out of 16) completed the survey (see Appendix). The survey also included four open ended questions to provide the opportunity for students to identify their concerns or other issues about the course in terms of their learning and satisfaction. The analysis of students' responses to these questions was carried out using a constant comparative analysis method with three phases: open coding, axial coding and selective coding [22].

IV. RESULTS

A. Transcript Analysis

There were nine weekly discussion topics. The transcripts were generated from these discussions. Transcript analysis was applied to code and explore posting patterns of social presence, teaching presence and cognitive presence based on indicators defined in the CoI framework [4]. The indicators for the categories associated with each of the presences facilitated the coding of transcripts and the means to

explore the nature, magnitude and progression of social, cognitive and teaching presence in the online discussions.

1. Participation in Discussions

Students' participation in weekly discussions was regularly recorded. For the online course, the total average attendance in the discussion forums was 92 percent. The average number of postings per week was 63 (564/9) and the average number of postings of a student per week was 4.3. Figure 2 shows the participation rates in the discussion board in weekly segments. The messages that the course instructor or the guest speakers posted were excluded from the table and calculations.

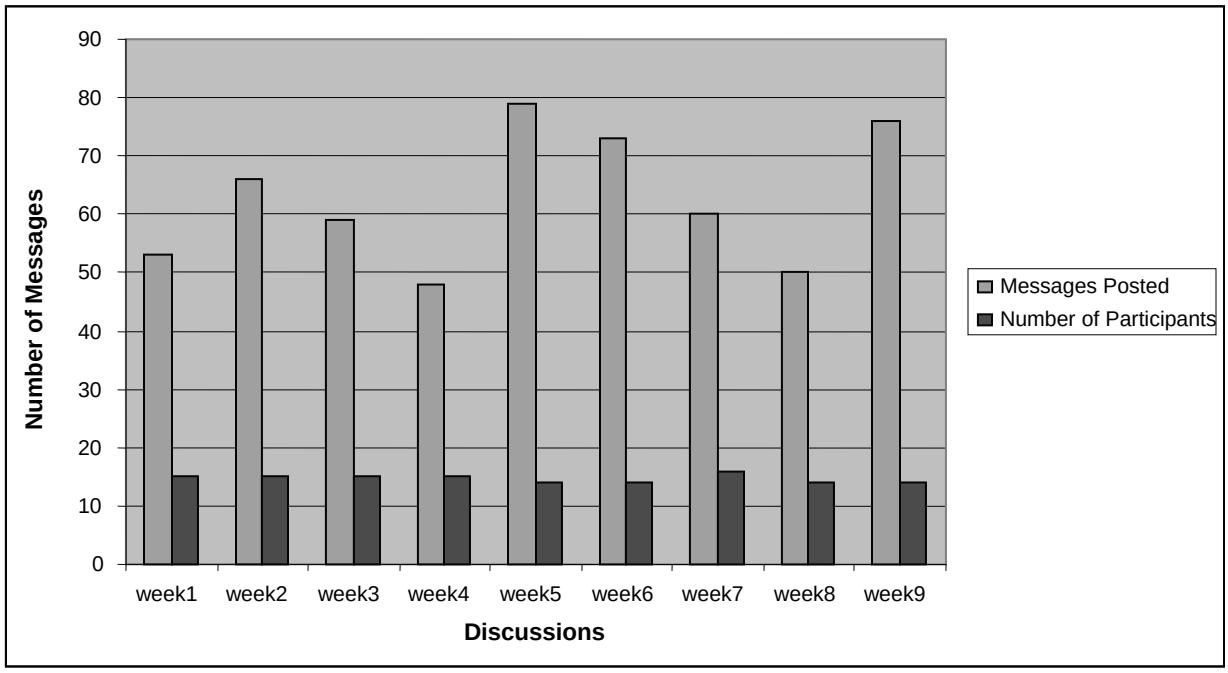

Figure 2. Participation in Computer Mediated Discussion Forum

2. Social Presence Over Time

Social Presence was analyzed in the transcripts by coding for affective expression, open communication and group cohesion. Table 1 illustrates the coding results for categories of social presence in three week periods. The majority of the messages throughout the course were open communication. However, the most obvious change occurred in terms of group cohesion as the percentage of group cohesion indicators increased over time.

Social Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Affective Expression	61	34%	77	39%	46	25%
Open Communication	104	58%	85	43%	80	43%
Group Cohesion	13	7%	31	16%	37	20%
No category detected	0	0%	7	4%	23	12%

Totals	**178**	**100%**	**200**	**100%**	**186**	**100%**

Table 1. Comparison of Coding Results for Social Presence within Three Time Periods

A 3X3 ANOVA with repeated measures was conducted to explore whether there were any changes in social presence posting patterns over time. The factors for the analysis were time (first 3 weeks, second 3 weeks and last 3 weeks) and categories of social presence (affective expression, open communication and group cohesion). As reflected in Table 2, the results did not yield a statistically significant time effect over social presence as a whole (p=.075), although the probability was approaching significance. However, the results showed a significant category effect on social presence which means that categories of social presence differed from each other (p<.001).

There is also a statistical significant time by category interaction effect (p=.009). To understand how this interaction affect occurred, testing of simple effects was performed. The analysis yielded that affective expression (p=.037) and group cohesion (p=.014) categories of social presence changed significantly over time. Figure 3 indicates that the affective expression category decreased over time while the group cohesion category increased over time. The analysis also yielded that, apart from the last time period, there is a significant variation among categories of social presence throughout the course.

	F	**Sig. (p)**
Time	F(2,30)=2.823	.075
Category	F(2,30)=14.159	.000
Time*Category	F(4,60)=3.755	.009

Table 2. F and p Values for 3X3 ANOVA with Repeated Measures and Social Presence Category Effect

		F	**Sig. (p)**
Category	Affective Expression	F(2,30)=3.70	.037
	Open Communication	F(2,30)=3.15	.057
	Group Cohesion	F(2,30)= 4.96	.014
Time	First three weeks	F(2,30)=12.93	.000
	Second three weeks	F(2,30)=16.78	.000
	Last three weeks	F(2,30)=1.91	.166

Table 3. F and p Values for Category and Time Interaction Effect

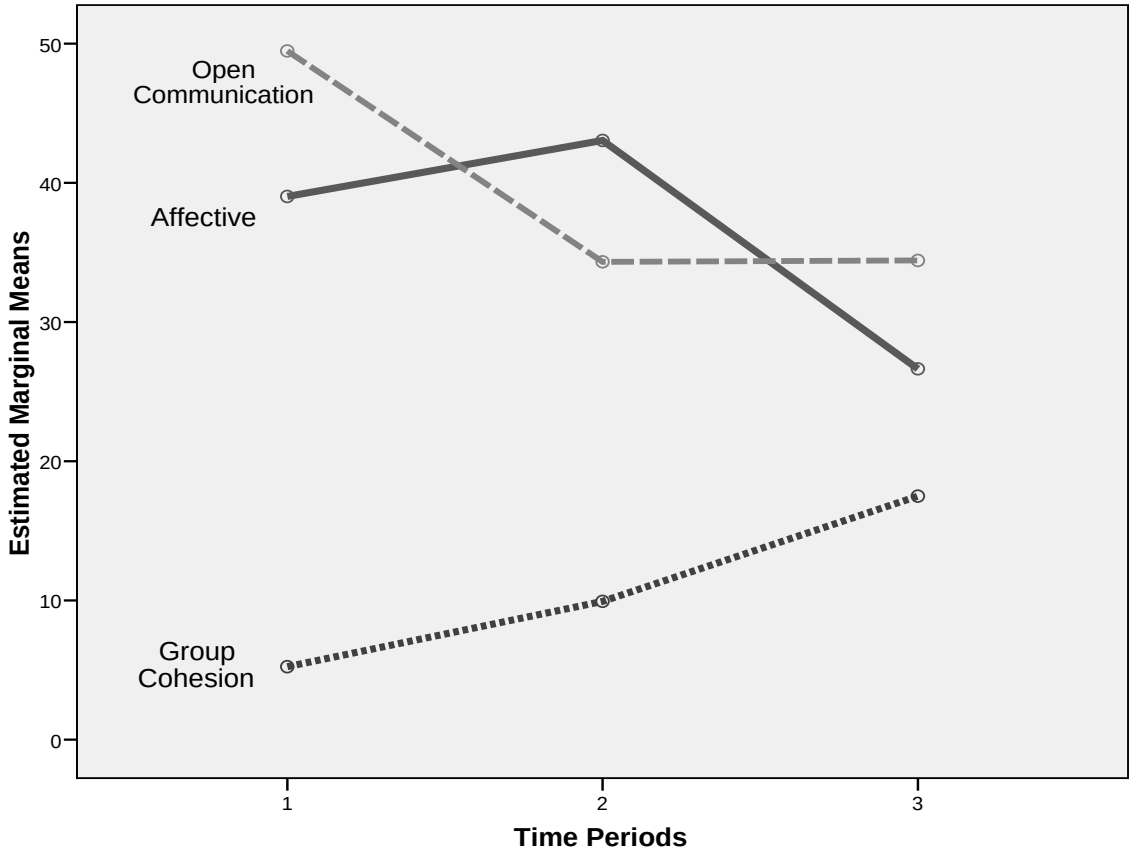

Figure 3. Plot of Social Presence Categories over Time

3. Cognitive Presence Over Time

Cognitive presence was analyzed in the transcripts by coding for the triggering event, exploration, integration and resolution. Table 4 illustrates the coding results for categories of cognitive presence over the three segments of time. As the distribution of percentages for each category of cognitive presence showed, the integration phase was the most frequently coded category of messages posted by students throughout the course.

Cognitive Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Triggering Event	26	15%	14	7%	15	8%
Exploration	32	18%	59	30%	50	27%
Integration	83	47%	90	45%	96	52%
Resolution	12	7%	19	10%	11	6%
No category detected	25	14%	18	9%	14	8%
Totals	**178**	**100%**	**200**	**100%**	**186**	**100%**

Table 4. Comparison of Coding Results for Cognitive Presence within Three Time Periods

A 3X4 ANOVA with repeated measures was conducted to explore whether there are any changes on cognitive presence postings patterns over time. The factors for the analysis were the time (first 3 weeks, second 3 weeks, and last 3 weeks) and categories of cognitive presence (triggering event, exploration, integration and resolution). The results in Table 4 showed a significant category effect on cognitive presence which means that categories of cognitive presence varied from each other ($p<.001$). However, the results did not yield a statistically significant time effect ($p=.829$) or time by category interaction effect ($p=.523$). Figure 4 shows the scatter plot for each category of cognitive presence over the three time periods.

	F	Sig. (p)
Time	F(2,30)=.189	.829
Category	F(3,45)=81.00	.000
Time*Category	F(6,90)=.866	.523

Table 5. F & p Values for 3X4 ANOVA with Repeated Measures and Cognitive Presence Category Effect

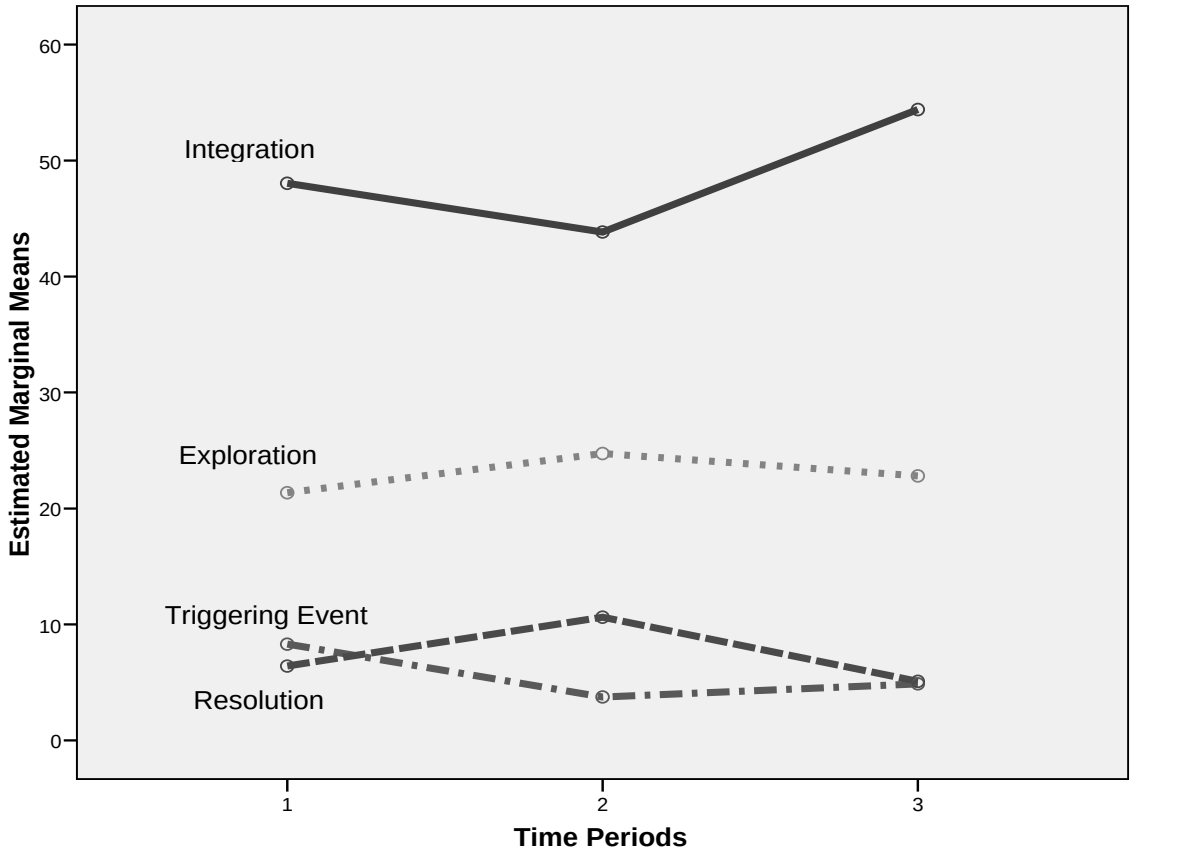

Figure 4. Plot of Cognitive Presence Categories over Time

4. Teaching Presence Over Time

Teaching presence was coded for design and organization, facilitating discourse, and direct instruction. Table 6 illustrates the coding results for categories of teaching presence in terms of three week segments. Design and organization was coded the least. There was also an increase in the number of messages coded

as direct instruction while facilitating discourse stayed more or less the same over time.

Teaching Presence	First 3 Weeks of Discussion		Second 3 Weeks of Discussion		Last 3 Weeks of Discussion	
	Totals	%	Totals	%	Totals	%
Design and Organization	1	1%	2	1%	0	0%
Facilitating Discourse	50	28%	46	23%	46	25%
Direct Instruction	33	19%	65	33%	70	38%
No category detected	94	53%	87	44%	70	38%
Totals	**178**	**100%**	**200**	**100%**	**186**	**100%**

Table 6. Comparison of Coding Results for Teaching Presence within Three Time Periods

A 3X3 ANOVA with repeated measures was conducted to explore whether there are any changes in teaching presence posting patterns. The factors for the analysis were time (first 3 weeks, second 3 weeks and last 3 weeks) and categories of teaching presence (design and organization, facilitating discourse, and direct instruction). As shown in Table 7, the results did not yield a statistically significant time effect over teaching presence as a whole (p=.272). However, the results showed a significant category effect on teaching presence which means that categories of teaching presence varied from each other (p<.001).

There is also a statistical significant time by category interaction effect (p=.001) which means that the category effect varies with time. To understand time by category interaction effect, testing of simple effects was performed.

	F	Sig. (p)
Time	F(2,30)= 1.361	.272
Category	F(2,30)=23.721	.000
Time*Category	F(4,60)=5.140	.001

Table 7. F and p Values for 3X3 ANOVA with Repeated Measures and Teaching Presence Category Effect

Table 8 shows the results of simple effect analysis for category by time effect. As shown in the table, direct instruction changes over time whereas there is no statistically significant change in terms of the design and organization or facilitating discourse categories over time. The design and organization category is likely coded the lowest because these activities were largely organized before the course began. Figure 5 shows the scatter plot of three categories of teaching presence over the three time periods. The graph illustrates the increase in direct instruction.

The simple effect analysis also yielded that there is a significant variation among categories of teaching presence across the three time segments.

		F	Sig. (p)
Category by Time	Design and Organization	F(2,30)=.96	.395
	Facilitating Discourse	F(2,30)=1.62	.215
	Direct Instruction	F(2,30)= 5.43	.010
Time	First three weeks	F(2,30)=7.76	.002
	Second three weeks	F(2,30)=11.31	.000
	Last three weeks	F(2,30)=31.12	.000

Table 8. F and p Values for Category and Time Interaction Effect

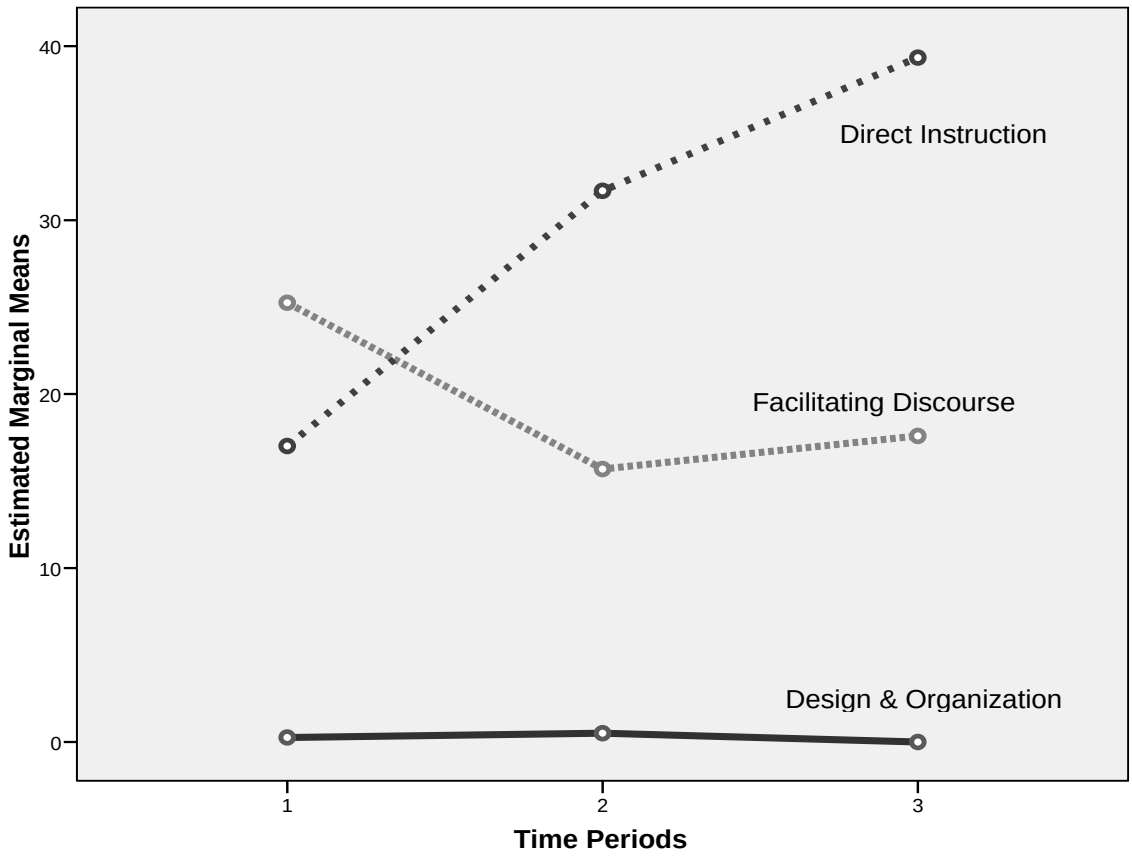

Figure 5. Plot of Teaching Presence Categories over Time

5. Community of Inquiry Over Time

A 3X3 ANOVA with repeated measures was conducted to explore community of inquiry changes over time. For this analysis, the factors were defined as time (first 3 weeks, second 3 weeks, and last 3 weeks) and each element of community of inquiry framework (social presence, teaching presence and cognitive presence). Table 9 shows the F and p values for this analysis. The analysis yielded a significant category effect ($p<.001$) and a significant time and element effect ($p<.001$). However, the results did not indicate a significant time effect on community of inquiry as a whole.

	F	p value
Time	F(2,30)=.024	.976
Element	F(2,30)=41.266	.000
Time*Element	F(4,60)=7.769	.000

Table 9. F and p values for 3X3 ANOVA with repeated measures and CoI Element Effect

To explore time and element interaction effect, testing of simple effect analysis was conducted. Table 10 shows the F and p values for this analysis. According to the results, throughout the course each presence significantly varied from each other for first three weeks ($p<.001$); for second three weeks ($p<.001$); and for last three weeks ($p<.001$).

The simple effect analysis did not yield a significant difference on any of the presences over time. Although the scatter plot in Figure 6 shows a continual decrease on social presence and continual increase on teaching presence, the probability did not reach significance.

		F	Sig. (p)
Category by Time	Cognitive Presence	F(2,30)=.19	.829
	Social Presence	F(2,30)=2.82	.075
	Teaching Presence	F(2,30)= 1.36	.272
Time	First three weeks	F(2,30)=33.94	.000
	Second three weeks	F(2,30)=35.87	.000
	Last three weeks	F(2,30)=19.81	.000

Table 10. F and p Values for Category and Time Interaction Effect

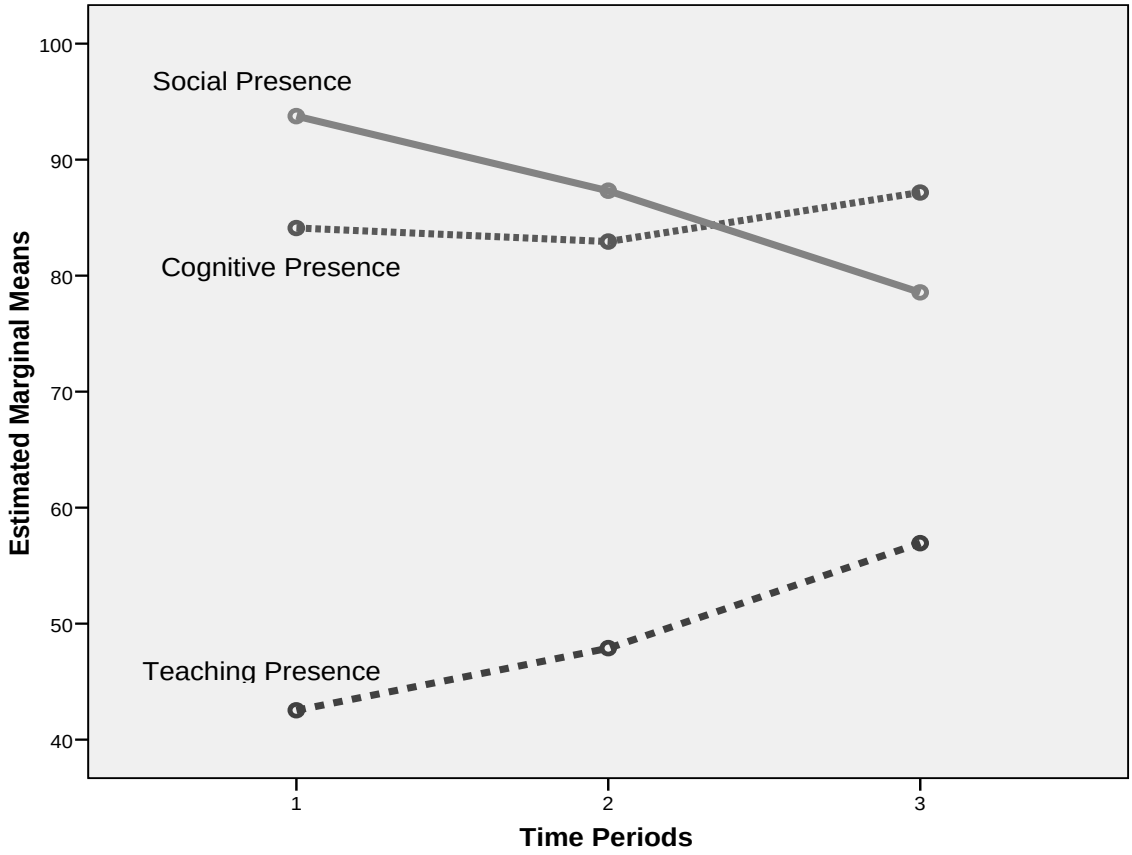

Figure 6. Plot of the Elements of Community of Inquiry over Time

B. Survey Analysis

The purpose of administering this instrument was to help gain a quantitative measure of the relationships among the presences as well as quantitatively associating each of the presences to common outcome measures such as perceived learning and satisfaction. It was expected that exploring the relationships of learning and satisfaction with the presences may provide some insights with regard to the different roles of social and cognitive presence. The descriptive analysis of the CoI survey showed that 15 out of 16 students completed the survey. Students had high perceptions of each presence in the course (see Table 11). The mean responses for all the presences were greater than 3. The students also agreed that they learned much in this course (M=4.21) and that they were satisfied with the course overall (M=4.42). The Spearman Rank Correlation Coefficient was conducted to explore the relationships among variables (teaching presence, cognitive presence, social presence, perceived learning and satisfaction). The analysis revealed significant relationships among perceived learning, perceived satisfaction, and levels of teaching, social and cognitive presence. As shown in Table 11, there was a positively significant relationship between teaching presence and cognitive presence (r=.78, p=.001), between teaching presence and perceived learning (r=.55, p=.03), between teaching presence and satisfaction (r=.63, p=.01) indicating that students who perceived higher levels of teaching presence also perceived higher levels of cognitive presence, learning and satisfaction.

Correlations

			Teaching Presence	Social Presence	Cognitive Presence	Perceived Learning	Satisfaction
Spearman's rho	Teaching Presence	Correlation Coefficient	1.000	.182	.779**	.548*	.634*
		Sig. (2-tailed)	.	.517	.001	.034	.011
		N	15	15	15	15	15
	Social Presence	Correlation Coefficient	.182	1.000	.490	.463	.539*
		Sig. (2-tailed)	.517	.	.064	.082	.038
		N	15	15	15	15	15
	Cognitive Presence	Correlation Coefficient	.779**	.490	1.000	.666**	.650**
		Sig. (2-tailed)	.001	.064	.	.007	.009
		N	15	15	15	15	15
	Perceived Learning	Correlation Coefficient	.548*	.463	.666**	1.000	.504
		Sig. (2-tailed)	.034	.082	.007	.	.055
		N	15	15	15	15	15
	Satisfaction	Correlation Coefficient	.634*	.539*	.650**	.504	1.000
		Sig. (2-tailed)	.011	.038	.009	.055	.
		N	15	15	15	15	15

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

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

Table 11. Relationships among Teaching Presence, Social Presence, Cognitive Presence, Learning and Satisfaction

The correlation coefficient also showed significant relationships between cognitive presence and perceived learning (r=.67, p=.007) and between cognitive presence and satisfaction (r=.65, p=.009), indicating that students who perceived higher levels of cognitive presence in the course also perceived higher levels of perceived learning and satisfaction. The analysis did not find a significant relationship between social presence and perceived learning, but found a significant relationship between social presence and satisfaction (r=.54, p=038).

Overall, it was found that all three presences showed a significant relationship with students' satisfaction. However, only two presences (teaching and cognitive presence) showed a significant relationship with perceived learning. This finding indicates that students think that they learn more when they perceive sufficient levels of teaching and cognitive presence. Their responses to open ended questions in the survey were also consistent with this result. Responses related to how and which aspects of teaching, social and cognitive presence affected their satisfaction and learning indicated that most of them emphasized the role teaching and cognitive presence had on their learning. With regard to the teaching presence, three students found teaching presence as the most important and critical one, whereas two students indicated both teaching presence and cognitive presence are key for their learning. Four students expressed that they were very satisfied with teaching presence in the course and teaching presence had the greatest impact on their learning. One student's statement about teaching presence was "*an instructor who has a strong presence and communicates effectively is a determining factor in whether or not I enjoy the course*." Six students, who stated that they were satisfied with cognitive presence in the course, pointed out that cognitive presence created a deeper awareness, provided meaningful learning, and led to construct-based learning. Only two students emphasized that social presence encouraged participation and was needed for cognitive presence. Two students indicated that all three presences were important to achieve meaningful learning.

With regard to the impact of sense of community on their learning, students indicated that it was particularly powerful for participation. One student indicated that he felt greater comfort in participating in course discussions. Another student compared the sense of community to reading paper material and sending in assignments in response and stated that "*The difference is, I've gotten to know the teacher and*

some of the students. I know that if I learn something I will be able to share it." On the other side, two of the students who indicated that they did not feel a sense of community expressed that they learned a lot from the instructor and course readings.

V. DISCUSSION

The primary focus of this study was how each of the presences and their categories evolved over time. However, at the outset, it should be noted that the categories of each of the presences were clearly distinguishable in the coding. Distinguishability provided the opportunity to analyze the development of the presences and their respective categories over time. Distinguishability also provided indirect support for the theoretical construct of the presences.

When analyzing the results of social presence it was found that affective expression decreased significantly while group cohesion increased significantly over the three time periods. Interestingly, affective expression remained high in the first part of the course, but as group cohesion began to rise, there would appear to be less need to overtly attend to affective expressions such as personal disclosure. It can be argued that collaborative activities increase students' sense of belongingness to the group which led them from an individual perspective to a group perspective. Moreover, some of the students' responses to open-ended questions also confirmed the importance of collaborative activities for their learning.

Another point worth noting, although not statistically significant, is that open communication was very high during the first two weeks and then dropped during the latter two time periods. Again, this would seem reasonable as students try to connect with others online by recognizing previous contributions. As they begin to feel more comfortable with the online discussion, the explicit personal recognition appears to drop. This is also not inconsistent with the findings that productive collaboration is likely dependent upon identity with a group and its purposes and less on individuals [11]. Another reason for the increase in group cohesion may be due to the nature of the online discussion board. Recent studies [23, 24] have shown the impact of different tools on social presence. There is evidence that group cohesion increases when students use a discussion board compared to traditional or email dialogue. While a definitive explanation of the social presence findings is not possible at this point, it does suggest that social presence is a dynamic multidimensional construct that is in need of further study.

With regard to cognitive presence, again we see a clear distinction among the phases of inquiry. However, notwithstanding the apparent increase in activity around integration, there were no statistically significant changes in the frequencies of the four phases of practical inquiry (i.e., cognitive presence). This was very likely due to the fact that the weekly discussion topics were similar in that they were progressively focused on designing a blended learning course (their final major assignment). The apparent spike in integration during the last three week period could be explained by the increase in knowledge injection from diverse sources, which is an indicator of the direct instruction category of teaching presence. As they began to use more sources, students' ability to support and to integrate their ideas with various resources increased. In general, it was encouraging to see the frequency of integration contributions considerably higher than exploration. This has not been typical of previous online studies [5]. One explanation is the design of questions in weekly discussions. The questions that triggered the discussion required students to explain and discuss the topics focusing on a specific aspect of their major assignment which enabled students to connect and synthesize their ideas for the purpose of resolution. The relatively reduced number of postings associated with resolution is explained by the fact that students very likely applied their resolution thoughts to their major course redesign project. There was not the expectation to share project insights with the other students. The length of the course is not enough for students to put their

projects in action and share the application results with the other students. The fewer number of messages at the resolution phase is also reported in previous studies [see 25, 26, 27].

The three categories of teaching presence were clearly distinguishable. While there was no significant shift in the categories over time, there was a significant interaction between categories and time. That is, direct instruction contributions rose over the three time segments while facilitating discourse dropped between the first and second time periods. The tentative explanation for the drop in facilitating discourse category is that students needed more encouragement and support during the first three weeks to express their ideas and then as they began to understand the expectations of online discussion, the need decreased and then stabilized.

However, the increase in direct instruction may have more than one explanation. The first explanation is that each week a group of students were responsible to facilitate the discourse. This encouraged them to be more active in terms of direct instruction (e.g., focusing the discussion on specific issues, diagnosing misconceptions, confirming understanding or injecting knowledge from diverse sources). Therefore, as time passed, more students gained experience and confidence in directing the discussion. Previous studies showed that taking the responsibility to lead a discussion is an effective way to enable students to fulfill each of the three roles of teaching presence and contribute to their learning [28]. A second explanation is that the triggering questions in course discussions were integrated with their major assignment. This encouraged the students to increasingly focus on their assignment which required more direction and clarity. Keeping in mind the increase on group cohesion, another reason can be that students felt more comfortable in the community to share and inject knowledge from diverse resources. As many have emphasized, social presence plays a critical role in creating an atmosphere of safety and trust for learning in community [29, 6].

The fourth repeated measures analysis looked at the community of inquiry as a whole through the progression of the three presences over time. The results showed both a clear distinction among the presences but not a significant time effect. Detailed analysis also confirmed that each presence was significantly different from the others at each time period. However, although the scatter plot showed a continual decrease on social presence and a continual increase on teaching presence, the analysis did not yield statistically significant differences on any of the presences over time. Of course, as discussed previously, time effects were evident within the presences.

Another point perhaps worth noting and speculating on is the corresponding rise of three categories in each of the three presences—group cohesion, integration and direct instruction. The question is whether there is any causal influence. It could be argued from a practical perspective that these three elements may in fact reinforce each other. That is, social presence through group cohesion and teaching presence through direct instruction supports integration and higher levels of cognitive presence (i.e., integration). While this is clearly hypothetical at this point, it is deserving of further study.

Finally, the survey results revealed a number of significant positive relationships between teaching presence and cognitive presence; teaching presence and perceived learning; teaching presence and satisfaction. This very much reinforces previous findings in terms of the crucial role of teaching presence in a community of inquiry [5, 30, 31]. The other set of significant relationships were between cognitive presence and perceived learning, and cognitive presence and satisfaction. Compared to teaching presence, cognitive presence was found to be a more influential factor on students' learning. It has been postulated from the inception that cognitive presence goes to the heart of the CoI framework. Although previous studies found significant relationships among social presence, perceived learning and satisfaction [32], the

results reported here only found a significant relationship between social presence and satisfaction. The question is how significant a role did social presence play? Does social presence significantly affect perceived learning? As one student indicated in his response to open ended questions in the survey, social presence allowed students to express their thoughts more comfortably, especially at the beginning of the course as they got used to their class mates and the learning environment. At the same time, it would seem that personal identity is secondary to the subject matter (i.e., cognitive presence) [33]. This may suggest that social presence is an important but perhaps not sufficient element in a community of inquiry. A recent study [13] indicated that social presence and teaching presence exhibited by the learners themselves supported cognitive presence.

VI. CONCLUSION

The results of this study strongly confirmed the distinction among the elements of the Community of Inquiry framework. The distinction has important theoretical implications. The findings also provide useful practical implications in that the three elements appear to develop and progress in different ways in an online learning environment. It was found that social presence and teaching presence along with their respective categories changed over time while the proportions of cognitive presence categories remained steady. Moreover, cognitive presence and teaching presence were important factors in influencing student learning and satisfaction. On the other hand, social presence had no impact on learning but was associated with satisfaction. It is suggested that the development and progression of each presence may well vary in contexts different from that studied here. For example, in this context, social presence was not found as important as teaching presence or cognitive presence in terms of student learning. However, social presence may well have more influence in informal learning environments, K-12 settings, or in online learning where students are new to this medium. Based on these results, it is suggested that the integration of the elements of a community of inquiry should be designed, facilitated and directed based on the purpose, participants and technological context of the learning experience.

The findings here are clearly limited by the small sample size. Notwithstanding this limitation, this study has taken an important first step in understanding the dynamic nature of a community of inquiry and each of its constituting elements and categories. It has been shown that both social and teaching presence showed evidence of significant dynamic changes over time. This was not the case for cognitive presence. There is some reason to believe that the nature of social and teaching presence will shift over time in the support of cognitive presence. The relatively constant nature of cognitive presence may well be a result of the design of the activities and the sample. While the results are interesting, only when we have a good understanding of the developmental progression of the presences and each of their categories will we be able to optimally integrate these elements in creating and sustaining a collaborative community of inquiry.

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VIII. APPENDIX

CoI QUESTIONNAIRE

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Teaching Presence					
The instructor clearly communicated important course topics					
The instructor clearly communicated important course goals.					
The instructor clearly communicated important course topics					
The instructor clearly communicated important due dates/time frames for learning activities.					
The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.					
The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.					
The instructor helped to keep course participants engaged and participating in productive dialogue.					
The instructor helped keep the course participants on task in a way that helped me to learn.					
The instructor encouraged course participants to explore new concepts in this course.					
Instructor actions reinforced the development of a sense of community among course participants.					

The instructor helped to focus discussion on relevant issues in a way that helped me to learn.					
The instructor provided feedback that helped me understand my strengths and weaknesses.					
The instructor provided feedback in a timely fashion.					
Social Presence					
Getting to know other course participants gave me a sense of belonging in the course.					
I was able to form distinct impressions of some course participants.					
Online or web-based communication is an excellent medium for social interaction.					
I felt comfortable conversing through the online medium.					
I felt comfortable participating in the course discussions.					
I felt comfortable interacting with other course participants.					
I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.					
I felt that my point of view was acknowledged by other course participants.					
Online discussions help me to develop a sense of collaboration.					
Cognitive Presence					
Problems posed increased my interest in course issues.					
Course activities piqued my curiosity.					
I felt motivated to explore content related questions.					
I utilized a variety of information sources to explore problems posed in this course.					
Brainstorming and finding relevant information helped me resolve content related questions.					
Online discussions were valuable in helping me appreciate different perspectives.					
Combining new information helped me answer questions raised in course activities.					
Learning activities helped me construct explanations/solutions.					
Reflection on course content and discussions helped me understand fundamental concepts in this class.					
I can describe ways to test and apply the knowledge created in this course.					
I have developed solutions to course problems that can be applied in practice.					

I can apply the knowledge created in this course to my work or other non-class related activities.					
Satisfaction					
Overall, I was satisfied with this course					
Learning					
I learned much in this course.					

Please answer the following questions below.

a) How has teaching, social and cognitive presence positively affected you in terms of satisfaction and learning?
b) Which aspects of teaching, social and cognitive presence has negatively affected your satisfaction and learning?
c) How has your sense of community positively or negatively affected your satisfaction and learning in this course?
d) Any other insights do you have in terms of the effectiveness of this course?

ACADEMIC DISHONESTY IN TRADITIONAL AND ONLINE CLASSROOMS: DOES THE “MEDIA EQUATION” HOLD TRUE?

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ABSTRACT

Limited empirical research exists regarding the prevalence of academic dishonesty in the online classroom. This limited evidence supports the notion that factors contributing to academic dishonesty in the traditional classroom also apply to online courses. The purpose of this study is to explore the relationship between factors known to contribute to academic dishonesty in traditional courses with undergraduate students’ perceptions of cheating in online courses.

1068 undergraduates enrolled in online courses completed a survey exploring factors known to contribute to academic dishonesty in face-to-face classes and their perception of their peers’ level of cheating in online courses. Researchers employed bivariate correlations and multiple regression on data obtained from these students. Results suggest factors known to contribute to academic dishonesty in face-to-face classes have little influence in online courses, and results suggest that future research needs to consider whether students who engage in online learning have different ideas about what constitutes cheating.

KEYWORDS

Academic Honesty, Cheating, Distance Education, Survey, Undergraduate

I. INTRODUCTION

There is limited research regarding the actual prevalence of academic dishonesty in the online classroom; much of the existing body of research focuses on aspects of plagiarism [1, 2, 3]. There is reason to believe that much of what is known about academic dishonesty in the brick and mortar classroom may also apply to online courses. Indeed, people routinely respond to computer-mediated situations in the same way they respond to real world situations [4, 5]. This phenomenon is frequently referred to as the “Media Equation” [4].

If students are exhibiting the same behavior in online courses that they exhibit in traditional classrooms, then instructors and designers of online courses have cause for alarm. A high percentage of students cheat in classroom-based courses [2, 6, 7]. Research suggests various personal and environmental factors that contribute to academic dishonesty [2, 8, 9].

The purpose of this study is to explore the relationship between factors known to contribute to academic dishonesty in traditional courses with undergraduate students' perceptions of cheating in online courses.

Specifically, we explore the relationships between 1068 undergraduate students' perceptions of the amount of cheating occurring in their online courses and the following factors which have been shown to contribute to academic dishonesty in traditional classrooms: (1) the number of credits taken during the semester [10, 11], (2) the number of hours spent weekly on the course [12] , (3) the perceived learning as a result of the course [13] and (4) the perceived amount of interaction with the instructor **[**14]. As such, the following question guided this exploratory research: Is there a relationship between cheating in online educational environments and variables traditionally related to cheating in a traditional educational environment?

II. METHOD

A. Participants

The participants were 1068 undergraduate students enrolled in 12 completely online psychology courses at a Research 1 university. The average class size is 90, with a range from 8 to 312 and a standard deviation of 80. The classes are populated primarily by 18–22 year-old undergraduate students from a variety of majors, with the largest concentration being psychology majors. Reviews of enrollment data have shown that students in these online courses are generally in later academic years and have higher GPA's.

B. Instrumentation

The instrument used to survey the population (Appendix A) was included as part of a question mid-term technical courseware evaluation. A more sound methodological approach to this research would have been to supply the survey at the end of the course, unfortunately, this was not logistically possible from an administrative standpoint. The first five survey questions dealt with aspects of student academic perceptions, two question offered students a free response option, these question asked students to report the number of credits in which they were currently enrolled and the amount of time they dedicated to classwork specific to the online course. Students responded to the remaining academic honesty questions via five-point Likert scales. The scales ranged from less likely (1) to more likely (5). The last two questions were free response items requesting student feedback regarding pedagogical and technical improvement of the courses offered to the population. It should be noted that the five point Likert scales limited the range of variability of student responses. While this is typically a concern with smaller data sets, the overall size of the sample (N= 1068) reduced the impact of the limited variability. Because of the limited number of items constituting the survey and the multidimensional structure of the data, the calculated Cronbach α of .07 will be ignored.

It is important to note that the questionnaire employed did not explicitly seek information about respondent's propensity to cheat or habits of academic honesty or dishonesty. In order to avoid collecting data constituting social desirable answers, a concern prevalent with research in academic honesty [15], the researchers asked participants to gauge whether others within their online class were engaged in

academically dishonest practices. Research by Jordan [16] indicates that among cheaters, the perception that those around them are engaged in academically dishonest behavior is more prevalent then amongst those who do not engage in academically dishonest behavior.

C. Data Collection

After the fourth week of class, a link appeared on each course homepage titled, "Research Survey". The target page stated that participation was voluntary, and that all submissions were completely anonymous. In addition, there was a link to the questionnaire. The questionnaire was administered using the WebCT course management software's survey tool. The questionnaire was available for one week. At the end of the week, the results from each course were downloaded and the questionnaire and results were deleted from the course. Results were analyzed and interpreted post-hoc utilizing SAS Business Intelligence and Analytics Software [17]. Due to the post-hoc nature of analysis, significance tests were two-tailed in nature, resulting in a minor loss of power. Because of the size of the sample, this loss of power had no significant effect on the overall results of the study.

D. Data Analysis

This study investigated the relationship between the independent variables and the perception that others enrolled within the distance education class were engaging in academically dishonest behavior (cheating). Independent variables included: perceived learning, perceived interaction, contact hours and number of credit hours currently enrolled. For the purposes of the study, perceived learning was defined as the amount of learning taking place within the distance education course as compared to traditional classroom-based courses. Perceived interaction was defined as opportunities for interaction with the instructor and/or teaching assistant as compared to traditional classroom based courses. Contact hours were defined as the number of hours spent during an average week completing course work. The dependent variable of measure, perceived likelihood of cheating compared to traditional classroom based courses, was measured on a five-point Likert scale. Pearson product-moment correlation coefficients were utilized to determine correlations between variables. Multiple linear regression was employed to detect the significantly predictive effect of the independent variables on the dependent variable.

III. RESULTS

A review of descriptive statistics derived from the study (see table 1) reveals that students reported the perception that there was less cheating in online classes as compared to face to face classes (mean = 2.74, SD = .95). Students also reported perceiving a higher level of learning as compared to face to face classes (mean = 3.32, SD = 1.00). Additionally, students reported perceiving a lower level of professor and TA interaction as compared to face to face classes (mean = 2.68, SD = 1.25). Pearson product-moment correlation among all variables were calculated, these results are reported in table 2. Multiple regression analysis of the sample (N=1068) showed that the interaction between the dependent variable (cheating) and the independent variables within a single block: contact hours, perceived learning, instructor interaction and contact hours were significant $F(4, 1068) = 20.6$, $p < .0001$. The model was able to account for 7% of the variance (adjusted R square = .07, (95% CI= 4.1%, 9.9%). It is important to note that the effect sizes of each of the interactions are relatively small, thus significance in the case of each interaction may be attributed to the sample size. Table 3 details the results of the multiple regression.

Table 1: Descriptive Statistics (n=1068)

	Mean	Standard Deviation
Perceived Cheating	2.74	.95
Perceived Learning	3.32	1.00
Perceived Interaction	2.68	1.25
Contact Hours	3.36	2.26
Credits	13.7	2.74

Table 2: Correlations Between Variables for All Subjects (n=1068)

	Cheating	Learning	Interaction	Contact	Credits
Perceived Cheating	1.00	-.20*	-.09*	-.18*	-.01
Perceived Learning	-.20*	1.00	.37*	.04	.03
Perceived Interaction	-.09*	.37*	1.00	.01	-.02
Contact Hours	-.18*	.04	.01	1.00	.10*
Credits	-.01	.03	-.02	.10*	1.00

*** p < .05**

Table 3: Results of the Multiple Regression Analysis of Cheating and the Four Independent Variables (n=1068)

	β	Standard Error β	t	Significance
Perceived Learning	-.19	.03	-5.88	<.0001*
Perceived Interaction	-.02	.02	-.079	.4302
Contact Hours	-.07	.01	-5.82	<.0001*
Credits	.004	.01	.38	.7044

*** p < .05, beta = 9.4 (assumes most pessimistic variance assumption)**

Table 4: Squared Partial Correlations Between Cheating and Four Independent Variables for All Subjects (n=1068)

	Squared Semi-Partial Correlation	Squared Partial Correlation
Perceived Learning	.0300	.0300
Perceived Interaction	.0005	.0005
Contact Hours	.0300	.0300
Credits	.0001	.0001

Table 5: Pearson Product Moment Correlations: Cheating and Four Independent Variables for All Subjects (n=1068)

	Perceived Cheating	Perceived Learning	Perceived Interaction	Contact	Credits
Perceived Cheating	1.00	-.2*	-.09*	-.18*	-.01
Perceived Learning	-.2*	1.00	.37*	.05	.03
Perceived Interaction	-.09*	.37*	1.00	.013	-.02
Contact Hours	-.18*	.04	.01	1.00	.10*
Credits	-.01	.03	-.02	.10*	1.00

*** p < .05**

A. Measure I: Perceived Cheating and Perceived Learning

The data indicates that a minor inverse relationship between perceived cheating and perceived learning when other factors are held constant. This indicates that those who perceived they were learning more within their classes were less likely to perceive that there is cheating occurring within their online course. While the findings were significant, the correlation between the two variables was relatively small at -.2 (see table 5). Application of multiple regression reveals a squared semi-partial correlation of .030 (see table 4). The squared partial correlation measures the association between the dependent variable, cheating, and perceived learning with all other variables held constant. Our analysis indicates that of the variance in cheating not associated with instructor interaction, credit hours and contact hours, on average, 3% is associated with perceived cheating.

B. Measure II: Perceived Cheating and Perceived Instructor Interaction

The data indicates that a minor inverse relationship exists between interaction with instructors and faculty and cheating when other factors are held constant. Meaning that, students who had more interactions with their instructors and faculty were less likely to feel cheating was occurring within their online course. While the findings were statistically significant, it is important to note that the spurious correlation between these two variables is extremely small at -.09 (see table 5). Application of multiple regression reveals a squared partial correlation of .0005 (see table 4). The squared partial correlation measures the association between the dependent variable, cheating, and instructor interaction with all other variables

held constant. Our analysis indicates that of the variance in perceived cheating not associated with learning, credit hours and contact hours, on average .054 is associated with instructor interaction.

E. Measure III: Perceived Cheating and Contact Hours

The data indicates that a minor inverse relationship between the perceived cheating and contact hours. This indicates that those who spent more time engaged in course oriented activity were less likely to perceive that cheating was occurring within their online course. While the findings were significant, the spurious correlation between the two variables was relatively small at -.18 (see table 5). Application of multiple regression reveals a squared partial correlation of .030 (see table 4). The squared partial correlation measures the association between the dependant variable, perceived cheating, and contact hours with all other variables held constant. Our analysis indicates that of the variance in perceived cheating not associated with instructor interaction, credit hours and perceived learning, on average 3% is associated with instructor interaction.

F. Measure IV: Perceived Cheating and Credit Hours

The data indicates that an extremely small inverse but non-significant relationship (at the .05 level) between perceived cheating and the number of credit hours that a student was enrolled in, when other factors are held constant. This indicates that there is no relationship between the number of credit hours that a student enrolls in and perceptions of cheating within an online course.

IV. DISCUSSION

The results of this study represent significant findings that deviate from traditional views regarding cheating in online courses. Our research suggests ideas regarding the factors that influence academic dishonesty in an online course need to be adjusted. While our results indicated that the independent variables accounted for a statistically significant amount of variance within the dependent variable, this amount was relatively small (adjusted R square = .07).

Kennedy, Nowak, Thomas and Davis [18] have asserted that distance learning environments provide and promote opportunities for academic dishonesty to a degree greater then found in traditional learning environments. The data reported within this study directly refutes this claim, instead indicating that a vast majority of students (81%) feel that cheating within their online course is no more prevalent then cheating within a traditional course. These results concur with the idea that beliefs regarding the rampant nature of cheating within online learning environments are based on anecdotal evidence at best and an argumentum ad populum at worst [19]. While this may be an encouraging notion, it is important to remember that regardless of whether in face-to-face classrooms or online, today's college students are engaging in academically dishonest practices with increasing prevalence [20, 21, 22].

Ultimately, there may be the need to consider whether students engaged in online education have a fundamentally different perception of what does and does not constitute cheating compared to those in traditional educational environments.

V. CONCLUSIONS

Our findings were unable to directly substantiate motivations for cheating within an online learning environment. Our supposition was that the factors that influence academic honesty within traditional

learning settings would also have significant influence and effect on academic honesty in online learning environments. This hypothesis did not hold true, providing an opportunity to question Reeves and Nass's [4] "media equation" phenomenon. Based on the results of the study it is appropriate to evaluate whether online students define cheating in the same manner as those engaged in traditional educational environments. Additional studies to gauge this understanding are needed. In addition, qualitative analysis should be employed in order to gain a comprehensive perspective regarding measurable constructs that could be utilized within a valid and reliable instrument to obtain a measure academic honesty in online educational environments.

VI. ABOUT THE AUTHORS

Erik Black and **Joe Greaser** are graduate students in the University of Florida's School of Teaching & Learning. **Kara Dawson** is an Associate Professor in the University of Florida College of Education.

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VIII. APPENDIX A

Dear Student,

We at the Psychology Department would like to ensure that we are serving your educational needs effectively in our web-based courses. In order to help us do so, we would greatly appreciate you taking just 2–3 minutes to give us your feedback on these important questions.

1. **What is the total number of credit hours you are currently enrolled in?**

2. **Compared to classroom-based courses I have taken in psychology, my experience is that the students in this online course are:**
   - **a. 1 = Less likely to cheat then in face to face courses**
   - **b. 2**
   - **c. 3 = As likely to cheat as in face to face courses**
   - **d. 4**
   - **e. 5 = More likely to cheat then in face to face courses**

3. **Compared to classroom-based courses I have taken in psychology, I am learning…**
   - **a. 1 = Less then in face to face courses**
   - **b. 2**
   - **c. 3 = As much as in face to face courses**
   - **d. 4**
   - **e. 5 = More then in face to face courses**

4. **Compared to other regular on-site courses I have taken in psychology, my experience is that in this online course the opportunities for interaction with the instructor and TA are:**
   - **a. 1 = Less frequent than in face to face courses**
   - **b. 2**
   - **c. 3 = As frequently as in face to face courses**
   - **d. 4**
   - **e. 5 = More frequent than in face to face courses**

5. How many hours a week do you spend, on average, completing course work (include ALL activities)?

THE EFFECT OF COMPUTER MEDIATED CONFERENCING AND COMPUTER ASSISTED INSTRUCTION ON STUDENT LEARNING OUTCOMES

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ABSTRACT

The trend toward increased technology in traditional higher education classrooms has been met with both optimism and criticism. One of the major criticisms of technology in the college classroom is that it does little, if anything, to improve student learning. Taking this view of technology into account, this study examined how the use of technology contributed to student learning outcomes after controlling for key student demographic variables. More specifically, this study investigated the use of computer mediated conferencing (CMC) tools (i.e., email and electronic discussion boards) and computer aided instructional (CAI) resources (i.e., the computer and Internet) to determine whether they contribute to student learning.

The sample utilized in this study consisted of 2000 college students, randomly drawn from the 2003 College Student Experience Questionnaire database. The survey included 53 Likert scale items with reliability ranges from .78 to .88 on each of the composite scales. The analysis of data consisted of four multiple regressions conducted on specific student learning outcomes. The student learning outcomes included four composite scales, measuring student 1) personal and social development, 2) general education gains, 3) intellectual development, 4) science and technology gains, and 3) vocational preparation.

After controlling for student's background variables, the findings of this study revealed that the use of technology in the college classroom does contribute to student learning. The model, including technology variables, explained 4% to 7% of the gains in student learning, while student background variables contributed an additional .03% to 2% of the gains. These findings, though modest, suggest that incorporating technologies in the college classroom can aid students in the learning process.

KEY WORDS

Learning Engagement, Computer Mediated Instruction, Higher Education, Instructional Technology, Learning Outcomes

I. INTRODUCTION

Advances in technology have created new channels for faculty-student interaction. Faculty members are becoming increasingly reliant on web-based technology as a resource for communication and a

supplement to course instruction. A study of technology in higher education in 2000 revealed that 60% of all college courses utilized electronic mail, as compared to 20.1% in 1995 [1]. A similar increase occurred in faculty use of the world-wide-web. This same study showed that 43% of college instructors used web resources as a component of their syllabus, as compared to just 11% in 1995. These types of courses are referred to as "web enhanced" because they incorporate both traditional and electronic approaches to teaching and learning.

Even with the tremendous growth in the use of web-based technologies in traditional college courses, the provision of new instructional tools for classroom instructors, and the innovative course scheduling options offered to students, not much attention has been paid to the effectiveness of these new technologies in contributing to the college classroom experience. Few studies have examined whether these new pedagogical tools increase actual learning. As a result of this lack of attention to the effectiveness of new technologies, there has been a surge in research that examines the impact of technology on student performance. The growth of this research related movement started in the 1980s. In the early research, theoretical principles related to educational technology were resisted in the analysis of both the research and data [2]. This study examines the actual effects of web-based technology on student outcomes utilizing a constructivist framework for analysis.

II. THEORETICAL FRAMEWORK

Since the late 1970s, constructivism has become one of the most well known and widely used theories of learning and has served as a framework for the study of learning in educational research. Constructivism in learning theory suggests that learners develop understanding through their own beliefs grounded in their background and knowledge base, past experiences, and new experiences. A constructivist view of learning rests on the assumption that knowledge is constructed by learners as they attempt to make sense of their environments. Learners must interpret and transform complex information based on their own knowledge and experiences. The metaphors of carpentry or architecture can be used to portray the constructivists emphasis on a dynamic process of individual development of understanding through building, shaping, and configuring meaning [3].

The emphasis of constructivist teaching is very different from the more traditional classroom lecture model, where lecturers seek to directly convey knowledge to students. Constructivism is based on the fundamental assumption that people create knowledge from the interaction of their beliefs, their existing knowledge, and the new ideas they encounter. Constructivists recognize the need to foster interaction between students and instructors. In the constructivist classroom, active student participation, peer interaction, critical thinking, and reflection are keys to learning. Additionally, collaboration is an integral component of the learning process. Within the schema of the constructivist model, learning becomes a communal activity that includes a focus on sharing cultural knowledge. Collaborative experiences provide students an opportunity to share understandings of course content, which promotes exposure to multiple perspectives. This additional exposure can, potentially, result in enhanced comprehension of course related materials.

Web-based technologies act as tools that assist learners in knowledge discovery and as conduits for collaboration. In essence, they aid two of the key principles of constructivism. Web-based technologies support constructivist environments by assisting students in gaining a clearer understanding of key concepts and ideas by providing access to multiple data and information sources. Through the Internet, learners are able to work interactively to discover rich resources that enable them to solve problems or construct knowledge. Similarly, computer mediated conferencing tools facilitate student collaboration and provide new pathways for learner communication and interaction. This can be done using synchronous

and asynchronous communications where participants share information in pursuit of meaning and construction of knowledge [4].

III. FACULTY AND STUDENT COMPUTER MEDIATED INTERACTIONS AND LEARNING OUTCOMES

Research on faculty/student interaction tends to focus on the traditional face-to-face mode of communication. Fewer studies focus on newer technologies, such as email. Even so, the literature related to these new communication technologies is expanding, and their findings appear to be mixed with respect to measuring student performance. For example, some studies reported positive results when teachers maintained daily e-mail contact with students [5, 6]. The results provide evidence that email can support learner knowledge and skill acquisition, and cognitive growth. Comparable results were also illustrated in Flowers' and Zhang's [7] study of 45,000 undergraduate students in the U. S. The results of this study showed that when students interacted with instructors via e-mail, they showed significant gains in science and technology knowledge, vocational skills development, personal and social development, and writing and thinking skills.

Conversely, some studies have shown no significant gains in student learning through e-mail interaction with instructors. One such study reported that student performance was not significantly impacted by communication technology, regardless of the amount of personalized electronic message posting by course instructors [8]. Though outcomes were not measured by a specific variable such as knowledge gains, Woods' study explored the ways students engaged in academic related activities to produce educational outcomes. More specifically, the study examined the extent to which personalized electronic messaging contributed to students' perceived sense of community, their satisfaction with their overall learning experience, and their establishment of a personal relationship with their instructor. It was recognized that regardless of the number of personal electronic messages sent to students throughout the semester, there was no statistically significant difference in perceptions between groups that received personalized emails and those who did not. These findings stand in contrast to studies conducted by Hu and Ku [5], Yu and Yu [6], and Flowers and Zhang [7].

Haworth [9] took a similar approach to Woods [8] to investigate the effectiveness of sending frequent personalized electronic messages to students. The findings of this study suggest that messages contribute little to the amount of student participation in class discussions. Increased use of personalized messages was seen as complementary communication by students who only sent one or two messages during the semester. It appeared that the use of electronic messages did not significantly increase student-to-faculty interaction but redistributed the contact to an alternative form. Similarly, Haworth [9] and Woods [8], Gatz and Hirt [10] reported that their sample of traditional-age, residential, first-year students (n=23) used email quite extensively, but only a limited amount of their correspondence enhanced students' ability to academically or socially integrate into their environment. Findings related to the effectiveness of learning through the use of email appear to be mixed, though there are slightly more studies showing the use of email can improve learning. The unresolved nature of these findings suggests that further exploration is warranted.

IV. COMPUTER ASSISTED INSTRUCTION AND LEARNING OUTCOMES

Computer Assisted Instruction is an interactive instructional technique that utilizes a computer to present instructional material, monitor learning, and select additional instructional material in accordance with

individual learner needs. CAI might also include *Computer Supported Learning Resources (CSLR)* which is the use of a computer as an access point for information. CSLR is a tool used by a learner in the learning process. In general, the literature suggests that the use of Computer Assisted Instruction (CAI) such as computer-based applications and the Internet, produce achievement effects superior to those produced through traditional instructional techniques [11, 12, 13]. These findings hold true for students of differing ages, abilities, and academic foci.

Some researchers have compared the effects produced by different forms of computer-based instruction (sometimes alone and sometimes as a supplement to traditional instruction) with the effects of traditional instruction alone [12, 14, 15]. Yaccub [16] conducted a meta-analysis and concluded that on the average, higher gains are produced with CAI instructional methods than with traditional teaching methods. His findings showed that the effect size is likely to almost double from .35 to .64 when CAI is utilized. However, some findings have shown no significant difference between traditional teaching methods and CAI [17, 18, 19].

It is important to note that it is difficult to compare two different modes of delivery. It seems as though when this is done, it is likely to reveal no significant difference between the two modes [20, 21, 22]. Each delivery mode should be viewed as a method to enrich the learning experience. This was best summarized by Dalton and Hannafin [11] who wrote, "while both traditional and computer-based delivery systems have valuable roles in supporting instruction, they are of greatest value when complementing one another" (p. 32). Therefore, instead of comparing media types, it is best to study how a particular instructional strategy adds value to the instructional method being employed. The use of CAI should be examined from the perspective of how it contributes to and enhances the learning environment.

Some studies have shown that CAI increases cognitive growth. One particular study analyzed the use of interactive media as an aid to students in a science course. At the end of the six week unit, there was an overall improvement of 24% in the number of correct responses, mainly in measures of higher level thinking skills, between pre- and post-tests. The findings revealed observable growth in both social and thinking skills. Media enriched and detailed examples of plant and animal fossils enabled students to better identify and classify them [23].

The use of CAI software has been reported to increase cognitive domain, higher-order thinking skills as well. Thornburg and Pea [24] examined the effect of using two software programs—Interactive Decision Envisioning Aid (IDEA) and Notecards—to train high school students in cognitive strategy and metacognitive strategy. The results showed that after the training in learning strategies from the software program, the breadth and depth of the subjects' argumentation improved significantly when compared to their knowledge and abilities prior to the instruction. Further, two months later subjects were able to retain these cognitive strategies. Though the sample size of the study (n=10) has the effect of weakening its impact, it still provides insight onto instructional design strategies that may have the potential to improve student cognitive performance.

Utilizing different types of software in instructional design can promote different types of interactions and learning outcomes among students [25]. Some researchers suggest that verbal interactions between students when using simulation software facilitate higher-order thinking by promoting peer interaction for problem solving [26]. Flowers and Zhang [7] found that using a computer for word processing, searching for information on the Internet, and analyzing quantitative information resulted in significant gains in writing and thinking skills. Word-processing software has been reported to encourage students to find solutions to a wide range of writing problems when used in a collaborative writing environment that

encourages extensive discussion [27].

Other researchers have reported that students are able to work longer and develop a better understanding of the writing process by working cooperatively on a writing task [28]. The word-processing environment is ideal for motivating students to discuss, reflect upon, and edit their work within cooperative groups. Additionally, participation and collaboration among students increases when they use computers in groups [29]. Word-processing applications also allow for more fluid, collaborative learning environments which are likely to produce a higher quality of interaction [27]. Users have the ability to add, delete, and rearrange text, allowing more congruency in the writing process than pencil-and-paper approaches. In turn, the use of word processors leads to better writing outcomes than the use of paper-and-pencil or conventional typewriters. Such outcomes include longer writing samples, a greater variety of word usage, a greater variety of sentence structures, more accurate mechanics, better spelling, more substantial revisions, greater responsiveness to teacher and peer feedback, better understanding of the writing process, better attitudes toward writing, and freedom from the problem of illegible handwriting [16, 30, 31].

V. PURPOSE OF THE STUDY

The purpose of this study is to determine whether a sample of students who frequently use newer communication tools, such as email threaded discussions, achieve significant gains in learning outcomes. More specifically, this study will examine:

1) The frequency of use of online collaboration (i.e., email, threaded discussions, or relay chat) and whether collaboration contributes significantly to student outcomes.

2) The frequency use of computer assisted instruction (i.e., computer and Internet) and its contribution to student outcomes.

VI. METHODS

This study utilized data from the 2003 *College Student Experiences Questionnaire* (CSEQ) database, which is housed at the Center for Postsecondary Research. The CSEQ is a national survey of randomly selected undergraduate students from colleges and universities across the United States. Institutions elect to participate in a paper-based version or a web-based version of the CSEQ survey. This study consists of a secondary data analysis of the web-based version of the 2003 CSEQ.

Invitations to participate in the survey were sent electronically. Student e-mail addresses were gathered from Fall 2002 enrollment data provided by participating institutions. Codes were developed by the agency administering the survey to track participant institutional affiliation. Data collection took place between May 2003 and September 2003. Participating institutions applied to CSEQ to become survey sites. Each institution provided email addresses for its student participants. A general announcement was sent (see Appendix A), inviting students to participate in the survey beginning in February of 2003. The survey web-site was open for three months. A hyperlink was embedded in the text of the email invitation, which directed participants to the instrument. To prevent multiple responses from the participants, students were required to submit contact information (e.g., name, social security number, and phone number), and if duplicates and non registered names were found, they were automatically removed. A follow-up email announcement was sent to non- respondents in April as a reminder. The web-based survey was closed and removed from the internet server in early September of 2003.

The CSEQ questionnaire is based on extensive research and guided by Chickering and Gamson's (1987) "Seven Principles for Good Practice in Undergraduate Education." The instrument utilized in this study includes 190 Likert-type items that relate to student academic experiences. For the purposes of this study, 53 items were selected from the two scales: 1) Estimate of Educational Gains (general education, personal development, science and technology, intellectual skills, practical and vocational competence) and 2) engagement (student acquaintances). Additional demographic data were collected in the latter sections of the instrument. The demographic variables included age, martial status, gender, race, living situation, educational status, parents' education level, and major field of study. For this study, only the gender, race, and educational level demographic variables were utilized.

The sampling frame for this study included students from various colleges and universities across the United States. The study operationalized a random selection in a sub-sample of 2,000 participants from the total national sample (n=87,855) of students who completed the CSEQ survey in 2003**.** The random sample was primarily composed of participants who were enrolled in some form of online instruction. The national sample included students enrolled in both online and traditional courses.

A comparison of the random sample and national sample clearly demonstrates the demographic similarities of the two groups. Most of the participants were female (63%), slightly higher than the national sample (61%) of women enrolled in four year institutions. Caucasian/White students made up the majority of the sample (78%), which is somewhat higher than the national sample (76%). The largest percentage difference between both groups was the enrollment status with a 19% difference between the random and national sample of freshman and sophomores sampled. Table 1 provides a demographic comparison between the random and national sample of the CSEQ participants.

The questions chosen for analysis in this study were based on a constructivist framework. First, demographic characteristics were analyzed to determine the effect that student background had on student learning outcomes. Second, questions related to student's ability to manipulate technology to expand their sphere of knowledge and to leverage the technology for gains in understanding were studied. Finally, student interaction and collaboration in the learning process were analyzed.

A. Reliability

Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with all participants. Another characteristic of a reliable instrument is stability; the degree to which participants respond in similar ways at two different points in time. For this purpose, Cronbach's Alpha was used. It ranges from 0 to 1.0. Scores that are at the higher end of the range (e.g., above .70) suggest that the items in a scale are related.

The Alpha coefficients for the learning outcomes scales range from .78 to .88, suggesting high reliability. Table 2 outlines the items and internal consistency estimates associated with the student learning outcome scales.

B. Measures

The measures used in this study will be outlined in two sections: dependent variables and independent variables.

1. Dependent Variables

Five student learning outcomes attributed to the college experience were assessed: 1) personal and social development, 2) general education, 3) intellectual development, 4) science and technology, and 5) vocational preparation. An analysis from the Buros Mental Measurement Yearbooks show that the items on the CSEQ scales are clear, well defined and have face validity, showing that logical relationships exist among same scales items [32].

Items on the questionnaire were measured on a 4 point Likert scale: 4 = Very Often, 3 = Often, 2 = Occasionally, 1 = Never. Cronbach's alpha estimates for the five scales were: 1) general Education, measured by six items (α = .79); 2) gains in intellectual skills, measured by seven items (α =.80); personal and social development measured by five items (α = .82); 4) gains in science and technology measured by four items (α = .89); 5) and three items measured gains in vocational preparation. (α = .78) Details on item wording, means, standard deviations and descriptive statistics estimates of measures are shown in Table 2.

2. Independent Variables

The independent variables or predictors for this study included 1) frequency of interaction via email, 2) frequency of collaborative work online, 3) frequency of computer use to prepare papers or reports, 4) frequency of use of the Internet for course related information. Participants responded to a 4 point scale: 4= Very Often, 3= Often, 2= Occasionally, 1= Never. All independent variables were measured as single items. Details on item wording, descriptive statistics, means, and standard deviation estimates measures are shown in Table 3.

C. Sets of Correlations

Inter-scale correlations were conducted on the independent and dependent variables to gain a better understanding of the strength of the scales. The results showed that there were significant correlations among the scales ($p<.05$). Correlations for the dependent variables were conducted first to measure learning outcomes. The r - values ranged from 20% - 75%, with the majority of the correlations falling within the 27% - 55% range, indicating a moderately strong relationship as shown in Table 4. The scale relating to students' personal and social development and intellectual skills showed the strongest relationship (r. =75). The scales with the lowest correlations were the social interaction scale and vocational preparation scale (r= .201).

A second set of correlations was conducted on the independent variables. Results showed moderate to low correlations on using email to communicate while the use of computer word processors presented the highest correlation at r =.480. Using email to communicate with classmates and joining in electronic discussions reported the lowest correlation at r = .134. All items showed a positive relationship and were statistically significant ($p<.01$) as displayed in Table 5.

VII. DATA ANALYSES

Data analyses were conducted using SPSS Version 12. Frequencies, descriptive statistics, and distributions were examined for all variables. Histograms, normal probability plots, and scatter plots were also created to determine whether the assumptions of linearity, normality, and homoscedascity were met. Item level analyses were carried out prior to creating the composite variables, and reliability estimates were calculated for each composite.

Multiple regression statistical analyses were conducted to analyze the data and find the best predictors of the dependent variables as they relate to learning outcomes. Regression was used to determine the contribution of the four interaction and technology use variables, above and beyond the impact of demographic factors, to the prediction of the outcome variables (i.e., learning outcomes).

The variables used in the regression equation were categorical in measure. To meet the assumptions of the model operationalized in this study, it was necessary for the dependent variable to be quantitatively or continuously measured. Dummy coding is the most commonly used coding method used to group data according to categories. Utilizing dummy coding, association in a given group or category was assigned a 1, whereas non-association in the category was assigned a 0. Groups that were given a 1 were expected to have higher learning outcome effects. For the purpose of the regression analyses, categorical variables, such as student gender, race, and class were coded as dummy variables. The specifications and the coding of the independent variables are listed below:

Gender. Student gender variable was dummy coded as:

0 = Male

1 = Female

Race. The race variable is dichotomized into Whites and non-Whites because of the low percentage of minorities represented in the sample. It was dummy coded as:

0 =Non-White

1 =White

Class level. In this study, the class level variable is coded into two categories:

Lower - mid level (freshmen, sophomores, and juniors) and seniors. The variables were coded as:

0 = Freshmen, Sophomore, Junior

1 = Senior

After coding the dummy variables, independent variables were entered in two blocks for each regression analysis. The demographic variables were entered into the first block, and then the group of interaction and technology use variables were entered into the second block. Thus, the independent contribution of each of the interaction and technology use variables could be estimated.

This study was based on the central assumptions that a) frequent use of computer mediated conferencing tools for collaborative interaction would result in greater learning outcomes, and that b) frequent use of computer assisted instruction would result in greater learning outcomes when demographic characteristics have been controlled.

VIII. RESULTS

As expected, the findings revealed that the use of technology does assist in explaining a significant amount of variance in learning outcomes, when demographic characteristics are held constant. For the data analysis both the unstandardized and standardized regression coefficients are reported in the tables. The interpretability of the unstandardized coefficients is somewhat challenging because the measures are truly not interval measures. Interval variables are equally spaced and have to represent equal magnitudes. It is unlikely that the unstandardized coefficients from the scale used (1= never to 4 = very often) would yield equal magnitude (e,g., there could be more gains from moving from never to occasionally than from

often to very often); therefore, the standardized coefficients will be used to gauge the relative importance of the independent variables in the explanation of student learning outcomes.

IX. REGRESSION MODELS FOR STUDENT LEARNING OUTCOMES

The focus of this study was the effect of CMC and CAI on student learning outcomes, after controlling for background variables. The five student learning outcome variables were regressed against the student background factors and technology use variables. The technology use variables were general education gains, personal and social development gains, intellectual gains, science and technology gains, and vocational gains. The regression models for student learning outcomes are summarized in Table 6.

The first regression model measures the contribution the use of technology made to students' general educational outcomes, revealing that background variables explain .003% of student learning. Contrary to initial expectations, the background variables do not make a significant contribution to gains in general education. When technology variables are added to the model, there is an R^2 change of 4%. Of the technology use variables, frequency of participation in electronic classroom discussions has the greatest effect on general education gains (B=.11), followed by searching the internet for course material (B=.10). The background and use of technology variables together explain about 5% of the total variance in general education gains ($p<.001$).

When examining learning outcome variables, the student characteristics of being white and being a senior appear to be fairly consistent. Background variables have a relatively small effect on student learning outcomes (.008% – 2.0%) for each of the five models. There is a slight negative association with being white in relation to each of the learning outcome variables, though none of the beta values are statistically significant. In contrast, being a senior is positively associated with all of the learning outcome variables. Three of these associations are significant (i.e., personal and social development, intellectual gains, and vocational gains). Being female is found to be positively associated with gains in personal and social development. There is also a negative relationship between being a female and gains in the area of science and technology. This negative relationship was found to be significant.

When the CAI technology related variables are included in the models, the resulting effects are fairly consistent across all of the learning outcome variables. Both searching the Internet and participating in electronic class discussion are key variables that help explain learning outcomes. In all five models, R^2 change was modest (3% - 7%) and statistically significant, indicating that the frequency of technology use does indeed contribute to the explanation of gains in student learning after controlling for background or demographic factors.

X. DISCUSSION

The researchers assumed that frequency of technology use would explain learning outcomes after controlling for background characteristics. The findings show that this assumption held true. In fact, the use of technology explained nearly four times as much of the variance in student learning as background variables. However, the relative effect of technology on student learning gains is not as great as initially assumed. Nonetheless, the learning outcomes percentage gain of 3–9 percent does provide a modest explanation of the effects of technology on learning within the context of educational psychology.

In the area of learning cognition, many factors contribute to student learning. Key areas that contribute to learning include teacher/instruction related variables [33], student-related variables [34], personal

characteristics [35], learning styles [36], and environmental elements [37]. Yet, by most standards, the ability of learning tools and/or resources to contribute to learning suggests a need for a regression model that focuses on learning gains. The effectiveness of learning technology tools combined with traditional instruction have typically contributed moderately to the overall gains in learning [31, 38].

XI. TECHNOLOGY AND ITS INFLUENCE ON LEARNING OUTCOMES

A. Computer Mediated Learning Tools

When taking into account only the use of computer mediated learning tools (email and electronic discussion), the findings in this study showed each was effective in explaining gains in learning outcomes (i.e., general education, personal and social development, intellectual growth, science and technology, and vocational gains). The findings of this study suggest that the utilization of collaborative learning tools modestly supports students in their learning processes. Additionally, collaborative learning tools facilitate discussion, and interaction among students and faculty.

The electronic discussion boards allow students to become active participants and they encourage both reflection and interaction [29]. Previous studies on collaborative learning have reported a moderate to strong relationship between various modes of collaboration and student performance [39, 40]. A possible explanation for the positive association between CMC utilization and learning gains is the effectiveness and ease of its use. More specifically, CMC allows discussions to be easily transmitted, stored, archived, reevaluated, edited, and rewritten. In addition, students enjoy a level of comfort with the more candid nature of CMC when sharing and discussing personal information that they may not in a face-to-face format. Thus, CMC can improve the overall quality of discourse [5, 41].

Studies of the contribution of CMC to learning by type of media have not shown strong evidence to support one mode of delivery over another. However, the findings from this study record only one significant relationship in learning gains through the use of email, and it was specific to personal and social gains. Both Haworth [9] and Woods [8] found the use of email to have positive effects on student academic and social integration. Though the methodologies of their studies are different, Haworth investigated online students and the types of messages sent while Woods examined online students and the frequency of messages sent, they both showed email having moderate effects as a learning tool. The results of this study showed that electronic discussions were more effective than email in explaining learning gains. Both electronic discussion boards and email are modes of asynchronous communication with similar user control features. The major difference between the two is that electronic discussion boards are centralized and controlled by the sender while email is decentralized--typically remotely located on the end users personal computer though still controlled by the sender.

The use of email is a favored communication tool for students who had an average mean score of 3.74 on a 4 point scale on the instrument used for this study. This score indicates that students used this method of communication very often. The electronic discussion boards had an average mean of 2.05, showing that students occasionally used this method. Although students' demonstrated a preference for email, it is possible that email is being used more for social communication than for academics. Additional evidence of this conclusion comes from this study's findings that students who use email show significant gains in the area of personal and social development and did not show gains in any other learning outcome area besides relatively small gains in science and technology. Though only a general conclusion can be drawn from this one finding, it does reveal a possible pattern. Additional research is warranted to gain a better understanding of why differences in effectiveness may exist between these two modes of electronic

communication when examining learning gains.

B. Computer Assisted Instruction

Two additional modes of technology investigated are classified as CAI tools (i.e., use of the computer word processor and the Internet). CAI tools allow learners to discover knowledge at their own pace. This is considered an exploratory form of learning. The Internet is a key piece of CAI related exploratory learning, allowing learners to search, retrieve, and evaluate information as it is displayed and permitting users to be in control of their quest for information. Findings from this study reveal that the use of the Internet is a moderate contributor to actual student learning outcomes. Searching the Internet has the greatest effect on three of the five learning constructs.

Though the effect size is moderate, the findings suggest that the Internet can be a somewhat effective tool in facilitating student learning. This finding is fairly consistent with other studies which showed that using the Internet allowed exploratory learning to occur that improved student academic performance [6, 7, 38]. Positive effects are likely to be associated more closely with ease of access and retrieval of educational resources on the Internet [6]. As the quality and abundance of resources on the Internet grow, it is likely that more positive learning gains may be seen.

It is somewhat surprising for the researchers not to find a significant relationship between the variable of computer use and learning, particularly since it is the most popular learning tool of all the technology variables. The use of a computer for projects or reports yielded the highest mean score (3.83 on a 4.0 scale) out of all the technology resources, showing that computers are frequently used learning resources for students. The impact computers can have on learning is further supported by other studies which have found that computers aide students in their cognitive growth [30, 42, 43].

The lack of effect of computer use on learning gains is likely due to its association to the term “word processor.” Because “word processor” was a separate independent variable and carried with it the suggestion that it enables learners to write papers for classes, this definition could have affected student responses on computer use. Students may use a word processor to write on topics such as politics and diversity, but not necessarily use to interact with faculty and other students, thus engaging in learning related activities. Students may use a computer word processing system to write papers and not necessarily use it as an interactive learning tool.

Some of the questions that measure learning outcomes revolve around the actions of search, retrieval, or interaction. The use of a computer does not necessarily provide an outlet for interaction unless a particular type of software is adopted to facilitate this process. For example, one of the questions that measures general education gains asked students to rate their efforts in developing an understanding and enjoyment of art, music, and drama. If students associated a computer with word processing, then it would be difficult for them to develop an appreciation for the arts because word processors are not used for this function. Quite the opposite is true for using the Internet. The Internet provides the capability to explore, view, and listen to files associated with the arts. A computer can have these same capabilities if the software permits. Because students may have associated the computer as just a word processing tool, the responses were likely distorted.

A second possible reason the use of a computer did not play a significant role could be a reflection of the instructional design, though this is a speculative assumption. This study was not designed to examine how technology is being used as an instructional strategy; however, it is known that simply providing learners

with hyperlinks to various websites will not yield productive results [44]. There must be an incorporation of instructional design principles, (i.e. content and learner analyses) to determine what students should know and be able to do with information [45]. Therefore, if proper instructional guidelines are not applied, it is unlikely that any measurable learning will result.

XII. IMPLICATIONS

The findings of this study have two immediate implications for instructional practice. First, the findings reveal that the use of electronic communication and computer-based resources provide complementary learning activities that aid the learning process. There is great interest and potential in web-based, flexible, learning with over 60 percent of instructors incorporating some form of technology as a part of their instruction [1]. While instructors are the focal point in most course settings, it should be noted that complementary learning activities are just as, if not more, important for practice. Research has proven that most learning occurs outside of the classroom environment and is strongly correlated with academic effort [46, 47]. Technology based learning resources provide important support in the classroom and complement what is being taught. Teachers should utilize technology-based resources to help learners be creators of knowledge through information research and content evaluation. These types of skills assist learners in becoming critical explorers rather than passive observers.

A second implication, related to instructional practice, is the need to select the appropriate media and to decide on the frequency of its use. Both the media and the frequency of use have the potential to enhance student learning outcomes if chosen and managed properly. Technologies that are capable of engaging students in interactive discussion with the instructor, peers, or an academic community can improve learning. Email and discussion boards were seen as the most effective technologies for facilitating interactive discussions. However, there must be a concentrated effort to develop strategies that promote subject matter relevant dialogue during the instruction development phase. These strategies need to take into account the frequency of access to, and duration of time spent on course content. Since in-class instruction is often limited, efforts should be made to encourage out of class learning activities that challenge students to probe, explore, clarify, explain, evaluate, and analyze written content with others. This provides student users the opportunity to learn from one another, using collaborative learning methods.

XIII. IMPLICATIONS FOR FUTURE RESEARCH

There are many opportunities for new studies on computer and web-based learning utilizing the constructivist theory as a general guideline. However, for the purpose of this study, two specific opportunities will be discussed. First, there is a need to examine other variables to advance the research in this area. Though finding good fitting prediction models was not the intention of this study, the models used herein had a relatively low R-square; that is, the independent variables and the control variables together only explained a small portion of the variances in learning outcomes. This relationship suggests that there might be other variables that have more significant effects on learning, which were are not included in the models used.

A second study to follow up on some unanswered questions regarding the definition of computer use would clarify any misconceptions between a word processor and computer. A computer serves as an electronic device that can store, retrieve, and process data. More important, perhaps, is to the need to clarify the differences in a computer and the software that can be used to complete certain tasks. Today, there are thousands of programs that enable computers, to design, to store, and to manipulate data in a manner that makes it easy for an individual to see them as one unit. It is very rare to purchase a computer

without any preinstalled software. Therefore, a follow up study would clarify any definitions or terms to ensure that there is a direct correlation between computer use and the task it enables users to complete.

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Table 1. Characteristics of CSEQ 2003 Sample

Characteristic	Online Sample n %	Online Sample n (n=2000)	National Sample n%	National Sample n (n=87,855)
Gender				
Male	35%	704	39%	33,560
Female	64%	1,272	61%	53,485
Race				
African American	4.6%	92	5%	4,356
American Indian/Alaska Native	.7%	13	1%	844
Asian/ Pacific Islander	4.8%	96	9%	7,529
Caucasian/White	78%	1,568	76%	67,277
Hispanic	3%	59	2%	1,630
Other	2.9%	57	3%	2,597
Multiple	3.7%	73	3%	3,090
Enrollment Status				
Freshman	20%	399	42%	36,733
Sophomore	41%	823	20%	17,506
Junior	11%	222	17%	15,096
Senior	25.7%	513	21%	18,520

Table 2. Items and descriptive statistics for learning outcomes

Items and descriptive statistics for learning outcomes

Variable	Scale Statistics	Items (with Codes)	Item-Level Statistics		
			Mean	Standard Deviation	Valid N
General Education			2.81	.893	1824
at=.79 as=.79	GNVOC	Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation)	3.01	.807	1824
	GNSPEC	Acquiring background and specialization for further education in a professional, scientific, or scholarly field	3.06	.758	1824
	GNGENLED	Gaining a broad general education about different fields of knowledge	2.51	.946	1824
	GNARTS	Developing an understanding and enjoyment of art, music, and drama	2.46	.974	1824
	GNLIT	Broadening your acquaintance with and enjoyment of literature	2.69	.932	1824
	GNHIST	Seeing the importance of history for understanding the present as well as the past	2.65	.955	1824
	GNWORLD	Gaining knowledge about other parts of the world and other people (Asia, Africa, South America, etc.)	2.94	.831	1824
	GNPHILS	Becoming aware of different philosophies, cultures, and ways of life			
Intellectual Skills			2.98	.834	1826
at=.81 as=.80	GNWRITE	Writing clearly and effectively			
	GNSPEAK	Presenting ideas and information effectively when speaking to others	2.95	.833	1826
	GNCMPTS	Using computers and other information technologies	3.05	.864	1826
	GNHEALTH	Developing good health habits and physical fitness	2.64	1.006	1826
		Thinking analytically and logically	3.05	.825	1826

	GNANALY				
	GNSYNTH	Putting ideas together, seeing relationships, similarities, and differences between ideas	3.14	.765	1826
	GNINQ	Learning on your own, pursuing ideas, and finding information you need	3.28	.755	1826

Note: at is the alpha for the national sample and *as* is the alpha for the sub-sample.

Table 2 (Continued)

Variable	Scale Statistics	Items (with Codes)	Item-Level Statistics		
			Mean	Standard Deviation	Valid N
Personal and Social Development **at=.83 as=.82**	GNVALUES	Developing your own values and ethical standards	3.18	.828	1834
	GNSELF	Understanding yourself, your abilities, interests, and personality	3.31	.717	1834
	GNOTHERS	Developing the ability to get along with different kinds of people	3.21	.778	1834
	GNTEAM	Developing the ability to function as a member of a team	3.03	.862	1834
	GNADAPT	Learning to adapt to change	3.18	.787	1834
Science and Technology **at=.87 as=.89**	GNSCI	Understanding the nature of science and experimentation	2.36	.983	1849
	GNTECH	Understanding new developments in science and technology	2.40	.962	1849
	GNCONSQ	Becoming aware of the consequences (benefits, hazards, dangers) of new applications of science and technology	2.44	.943	1849
	GNQUANT	Analyzing quantitative problems (understanding probabilities, proportions)	2.58	.973	1849
Vocational Preparation	GNCAREER	Gaining a range of information that	3.06	.782	1848

at=.78 as=.78

			2.81	.983	1848
	GNVOC	Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation)			
			3.01	.809	1848
	GNSPEC	Acquiring background and specialization for further education in a professional, scientific, or scholarly field			

Note: at is the alpha for the national sample and *as* is the alpha for the sub-sample.

Table 3. Items and Descriptive Statistics for Independent Variables

Items and descriptive statistics for independent variables

Independent Variables	Items	Mean	Standard Deviation	Valid N
Frequency of interaction via email	Used email to communicate with an instructor or other students	3.74	.567	1903
Frequency of collaborative online Work	Participated in class discussions using an electronic media (email, list serve, chat group, etc.)	2.05	1.045	1903
Frequency of computer use to prepare papers or reports	Used a computer or word processor to prepare reports or papers	3.83	.471	1903
Frequency of Internet use for course related information	Searched the World Wide web or Internet for information related to a course	3.51	.723	1903

Table 4. Correlations among Dependent Variables

Correlations among Dependent Variables (N = 1921)

Dependent Variables	General Education Scale	Voc Scale	Sci. Tech Scale	Per. Soc. Scale	Intellectual Skills Scale
General Education Scale	1				
Voc. Scale	.607**	1			
Sci. Tech Scale	.368**	.438**	1		
Per. Soc. Scale	.541**	.489**	.410**	1	
Intellectual Skills Scale	.595**	.526**	.534**	.749**	1

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

Table 5. Correlations among Independent Variables

Correlations among Independent Variables (N = 1921)

Independent Variables	Used computer/word processor for paper	Used email to communicate with class	Joined in electronic class discussions	Searched Internet for course material
Used computer/word processor for paper	1.00			
Used email to communicate with class	.480**	1.00		
Joined in electronic class discussions	.134**	.192**	1.00	
Searched Internet for course material	.346**	.412**	.279**	1.00

** p< .01

Table 6. Regression Model for Technology and Student Learning Outcomes

Regression Model for Technology and Student Learning Outcomes

Independent Variables	General Education Gains (*N*=1768)		Personal and Social Development Gains (*N*=1768)		Intellectual Gains (*N*=1779)		Science and Technology Gains (*N*=1790)		Vocational Gains (*N*=1791)	
	b	*B*	*b*	*B*	*b*	*B*	*b*	*B*	*b*	*B*
Gender	-.01	-.001	.09**	.07**	.14	.01	-.24***	-.14***	-.03	-.02
Race	-.19	-.02	-.03	-.02	-.07	-.05	-.12	-.06	-.04	-.02
Senior	.54*	.05*	.17***	.12***	.18***	.14***	.06	.033	.12***	.09***
R^2 Background Variables		.03		.02***		.02***		.02***		.08**
Gender	-.22	-.02	.05	.04	-.02	-.02	-.25***	-.15***	-.06	-.04
Race	-.08	-.07	-.02	-.01	-.05	-.03	-.11	-.05	-.03	-.02
Senior	.38	.04	.14***	.10***	.16***	.13***	.05	.02	.11**	.07**
Used computer / word processor for a paper	.44	.05	.01	.01	.05	.04	-.09	-.05	-.02	-.01
Searched the Internet for course related material	.64***	.10***	.11***	.13***	.12	.16***	.14***	.12***	.10***	.11***
Used email to communicate with class	.38	.05	.10***	.09***	.07	.07	.01	.008	-.02	.07
Join In electronic class discussions	.46***	.11***	.06***	.10***	.06***	.10***	.08***	.11***	.05**	.08**
Change in R^2		.04***		.06***		.07***		.03***		.04***
Total R^2		.05***		.08***		.09***		.05***		.04***

*p<.05, **p<.01, ***p<.001

XV. ABOUT THE AUTHORS

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REFLECTIONS FROM THE MOVING THE LABORATORY ONLINE WORKSHOPS: EMERGING THEMES

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ABSTRACT
How to move science-based labs online has been one of the main obstacles associated with the development of online science programs. In the spring of 2006 and again in 2007, we organized online workshops broadly based around the central theme of Moving the Lab Online. The objective of these workshops was to provide a forum for the exchange of ideas, thoughts, and experience associated with the challenges of moving science labs into the online environment. Produced by Sloan-C, the first workshop, entitled "Practical Techniques for Utilizing Remote Instrumentation to Enhance Science Education," focused primarily on the technical aspects of using remote instrumentation. The second, entitled "Changing the Laboratory Learning Experience Using the Online Environment," looked at issues associated with teaching online labs using remote instrumentation. A number of similar themes emerged from these workshops. These ranged from a need to better articulate the role of the laboratory experience to questions of whether labs even need to be part of the online science learning experience, to the need for the development of best practices. This paper presents the authors' reflections on the prominent themes and discussions that emerged from the Moving the Lab Online workshop series.

KEYWORDS
Online Laboratories, Remote Instrumentation, Online Learning

I. INTRODUCTION

The Internet and the online environment have already become indispensable tools for practicing scientists, supporting a variety of research and collaborative activities ranging from remote surgeries [1, 2], to planetary and space exploration [3, 4], to real time earth observatories and ocean-floor laboratories [5, 6], to data mining and data sharing [8, 9] and teaching [10, 11, 12, 13, 14, 15, 16]. Science is now routinely conducted in a decentralized environment with collaborating scientists located around the world building virtual communities and sharing resources. A diverse range of online tools such as desktop sharing, video and web conferencing, and course management systems support these activities. Shouldn't the teaching labs of today also embrace these online technologies and practices as the reality of how science is conducted? Shouldn't we incorporate them into the teaching laboratories as essential for the development of science literacy and for educating new scientists? We believe this is true. We also believe in the need to identify and develop these tools for use in both online and face to face teaching and learning environments in a way that ensures that we are not simply replicating the traditional laboratory experience online. Rather, the online environment should be used to create new, more authentic learning

opportunities by exploiting the strengths of the available online tools to create new and more effective learning opportunities in the laboratory-based sciences.

These questions formed the basis of two "Moving the Lab Online" workshops organized by the authors and produced by the Sloan-C in the spring of 2006 and 2007. The objectives of the workshops were to provide a forum for the exchange of ideas, thoughts and experience associated with the challenges of moving science labs into the online environment. Moodle was used as the primary workshop delivery platform administered by Sloan-C with individuals from a number of institutions providing recorded Macromedia Breeze presentations related to their experiences developing and conducting online labs. Additional information, from literature references, to links to web-based resources, to the ability of participants to connect directly to remote instruments, provided additional content to support each of the workshops. Discussion forums and a final live session using Elluminate Live! allowed presenters and participants to more fully develop and extend ideas developed during the workshop. This paper provides the authors reflections on some of the central themes that emerged from the Moving the Lab Online Workshops.

A. Redefining the Teaching Laboratory

Instructional laboratories have historically been accepted as essential for the training and education of scientists and for the promotion of science literacy in general. At most institutions, individual laboratories are typically conducted in three or four hour time blocks one or two days a week. During these laboratory periods, students usually follow scripted procedures to achieve some predetermined experimental outcomes with little or no opportunity to repeat, expand, or modify experiments based on observations or interpretation of experimental data. In fact, laboratory activities are often so tightly controlled that they do not resemble working laboratories at all and often fail to convey the excitement of research and discovery. This is true across the scientific disciplines from Anatomy to Zoology, raising many important questions as to the purpose of teaching laboratories and whether they are, in fact, effectively training and educating students to be scientifically literate let alone practicing scientists. As educational institutions regularly commit significant financial, personnel, space, and other resources to support teaching laboratories, these types of questions are becoming increasingly important, causing some institutions to either reduce or eliminate teaching labs altogether or to explore opportunities, such as the use of online and virtual labs, as alternatives to traditional laboratories. However, as we migrate toward the use and development of these online resources, we need to ask whether the traditional laboratory is the model we want to move online, or should we be looking at the online environment as a new and/or complementary way to improve education and training in the sciences.

What are teaching labs and why have they evolved into the form they generally have today? Look at a typical course catalogue from any university and it quickly becomes apparent that there is no common description or definition of a teaching laboratory that can be adopted universally. There are computer labs, field labs, chemistry labs, engineering labs, marine labs, anatomy labs, and even art and language labs to name just a few, each with their own set of activities and student responsibilities. Laboratory objectives that specifically articulate the knowledge, skills and values to be developed during the laboratory are rare. Common features among labs, however, tend to be the use of a specialized space (usually a bricks and mortar laboratory or room), block timetabling, and the manual manipulations of physical samples. Whether painting a portrait, mixing chemicals, looking through a microscope, dissecting specimens or building a circuit, these manipulations are commonly referred to as "hands-on" activities, the objectives of which, at least superficially, are knowledge application (from associated lectures) and the development of discipline related technical skills. We asked our workshop participants how they would define a lab and why labs so often take this form and found that a universal definition of a teaching lab as well as the rationale for typical laboratory format was elusive. This finding mirrored the

findings of a recent National Research Council's commissioned report, "*America's Lab Report: Investigations in High School Science"* [17]. In the absence of a common definition for a laboratory, the report promotes the concept of the "laboratory experience" as stated below:

> Laboratory experiences provide opportunities for students to interact directly with the material world (or with data drawn from the material world), using the tools, data collection techniques, models and theories of science.

Shifting our thinking away from defining an online laboratory to that of developing an online laboratory experience will allow us to more effectively exploit the online environment for the delivery of laboratory-based sciences. This idea is supported by the report's association of laboratory experiences to include "teaching and learning that may take place in the laboratory room or *in other settings*" that include "interaction with simulations" and "remote access to scientific instruments and observations" [17]. This view represents a significant departure from the traditional belief that science has to be taught as a series of "hands-on" activities conducted in a specialized space within a defined timeframe. In other words, the laboratory experience can and should occur, using the central mantra of the online community, anytime/anyplace. What does this say about moving laboratories online? Perhaps the most important concept that we should focus on is using the online environment to provide a significant *laboratory experience* rather than trying to replicate the traditional face-to-face laboratory. This, in fact, was one of the central themes to emerge from the Moving the Labs online workshops and one that we are currently striving to develop as part of the Integrated Laboratory Network (ILN) Project. Discussion forums related to this topic can be found at the ILN project Moodle site available online [18].

B. The Need for an Online Consortium and the Associated Development of Best Practices

Although a variety of institutions and groups across multiple disciplines have approached the development of online science labs, most of these activities have occurred in isolation [11, 12, 13, 14, 15, 16]. Currently there is no consortium, such as Sloan-C, to serve as a centralized organization to nurture the idea and to gather and provide easy access to information, resources and networking opportunities associated with the development of online labs. Interestingly, during the workshops frequently asked questions typically began with "How do I…?" or "Where can I…?" These questions sought examples of conducting online labs within specific disciplines. The lack of a central repository of information represents a significant hurdle to actually moving labs online and leads directly into the next theme to develop from the workshop; that is, what are the best practices associated with moving and delivering laboratories online?

The lack of defined best practices and clear examples associated with the design, development, and delivery of online labs makes moving labs online extremely challenging. Those currently involved in the field are charting new territory and, by default, are establishing the best practices. This is both good and bad. For one, it is intellectually very interesting to work on the challenges of moving labs online: the research generated from this work will make an important contribution to the emerging scholarship of teaching and learning science online. On the other hand, early adopters are at a critical development stage in the evolution of moving labs online. That is, efforts to move labs online that produce poor outcomes (student dissatisfaction, poor quality of program delivery, poor quality materials, and poor overall student experience) have a significant potential to negatively impact the acceptance of online labs. Our failures could surely hurt us more than our achievements will help us as we strive to gain acceptance of online labs as a legitimate avenue for the delivery of science education. To this end, it is essential for those involved in the development of online labs and programs to actively work within their professional

societies to promote the acceptance of online labs. This includes, among other things, disseminating the research findings at meetings, organizing symposia, collecting assessment data, and publishing. Ultimately however, a consortium needs to develop that will serve to bring individuals and institutions from a variety of disciplines together in a learning community to develop and share best practices. This may ultimately be done under the umbrella of an established group such as Sloan-C. Alternatively, it may have to come about independently as a critical mass of practitioners active in the development of online labs develops through projects like the ILN [11], iLabs [12] or CASPIE [13] programs. In any case, a consortium that develops and promotes best practices will be an important resource for institutions and individuals interested in moving labs online.

C. Addressing the "Hands-On Issue

One of the arguments heard most often against moving labs online has been the need for "hands-on" activities as part of the student's laboratory learning experience. Indeed, we believe that the argument for the need of a hands-on experience is directly related to two sets of skills commonly associated with the scientific process. These are the ability to observe and the ability to manipulate. Observations of sights, sounds, smells, and touch provide important clues about natural systems, while the ability to manipulate things that are observed allows scientists to test hypotheses and draw conclusions. Can these skills be taught online? Certainly, online technology will continue to improve and may facilitate these processes in the future. Emerging technologies providing online tactile feedback, audio/video and robotic technologies, and even digital scent technologies may provide students with new opportunities for developing these hands-on skills. However, although clearly on the horizon, the real impact of these technologies remains some years away.

In the meantime, how do we address the hands-on argument with the online technologies of today? First, we must understand a disconnection between the *intent* and the *reality* of providing students "hands-on" experience in the traditional teaching lab. The *intent* is that students have an authentic laboratory experience that leads to a deeper understanding of natural systems by allowing them to observe and manipulate objects in the material world. The *reality* is that time limitations associated with most labs generally mean that hands-on activities tend to be limited and are used primarily to train students in the technical skills used by practicing scientists. As mentioned earlier, at most institutions today, the commitment to the hands-on laboratory experience is embodied in prescribed procedures, predetermined experimental outcomes and strict timelines. This format does not resemble an authentic laboratory experience and undoubtedly evolved, in part, if not primarily, to time management concerns and class size. Given the fact that a limited number of lab hours are available, science programs have doled out the time in a way that at least provides all students with a higher education version of an authentic laboratory experience. Students may work in large groups that prevent many of them from using, or even putting much thought into the use of laboratory equipment and procedures. They may not have to think about their observations or even the reason for their lab experiments or to wonder what they would do next based on their observations. This form of hands-on laboratory experiences has been deemed more valuable than having no hands-on experience, even if this experience is far removed from the experience in actual laboratories. Is this approach a good use of time and resources?

This being said, perhaps we need to rethink the role of the teaching lab. If we look at the mechanics of delivering laboratories to large numbers of students, it is clear that the time that students spend in the labs should be used wisely. Unfortunately, existing bottlenecks slow the movement of students through a typical lab and therefore limit the opportunities to use the available laboratory time more effectively. For example, access to specific resources, such as instrumentation, is one such bottleneck. Instruments can often only analyze one sample at a time and some of these analyses can take minutes to hours to conduct. Further, access to these instruments is generally only available during the specific class time. Because the

use of instrumentation is often one of the essential hands-on activities in a lab, movement in the labs tend to be slowed until every student, or more realistically, group of students, has had a chance to use the instrument to analyze a sample.

This is one example of a bottleneck that the online environment can remove, thereby radically changing the way we conduct labs. When instruments, virtual simulations, and associated training and lecture materials can be remotely accessed twenty-four hours a day for the analysis of samples, the instrument access bottleneck is removed from the lab. Of course this means redefining the hands-on experience as one that includes the use of remote instrumentation and virtual simulations. This also means that more time is available to develop realistic experiences within the face-to-face lab, such as conducting real research, field studies, or engaging in higher-level experimental design. Well designed remote labs have the potential to significantly enhance learning outcomes across multiple disciplines and could do so 24/7, opening the door for a wide variety of new learning opportunities and collaborations.

D. Rethinking the Laboratory Experience: Blended and Alternative Laboratory Delivery Mechanisms

1. The Blended Lab

Perhaps the greatest impact the online environment will have relative to moving labs online will be for the development of blended laboratory activities. For example, a major difficulty to teaching labs, and in fact a major criticism of labs in general, has been a disconnection between lecture and laboratory activities. Often, due to large class size and limited lab resources, lectures and laboratories are out of sync, requiring students to cycle through different laboratory activities in groups with no effective background preparation. As a result, labs become an exercise in following instructions rather than a mechanism for providing new experiences or building upon previous practice. The online environment could be an ideal method for bridging the gap between lecture and laboratory. Resources related to the labs, including laboratory simulations and training materials, can easily be compiled and presented within the online format. Forums can be established that allow groups to share data as well as laboratory experiences. For example, posting problems that may arise while conducting labs for others to avoid or allowing groups of students to compare and comment on results would support student learning needs and build community in the classroom. In theory, the online environment will allow interactions between different sections of the same course as well between different courses. Many times, the same instruments and similar procedures are used in multiple courses. By providing online access to training materials as well as to the instruments themselves, instrument use can be reinforced both vertically and horizontally throughout the curriculum.

2. The Power Lab

An alternative to the traditional lecture/laboratory course would be the Power Lab. In this scenario, the lecture materials for a course, such as general chemistry, could be presented entirely online, with a face to face laboratory offered asynchronously for short, intense periods. For example, labs could be offered for a week during spring break, intersession, or summer session rather than in three hour blocks. Full-day labs for a one week session would easily cover the typical 30 laboratory contact hours available in a 10-week face to face general chemistry course. If the online course included extensive materials covering laboratory techniques as well as orientation and training sessions with remote instrumentation, students would come to labs better prepared to conduct specific laboratory activities. This could be accommodated with the use of case studies designed to help students to understand and operate the required laboratory instrumentation. Successful completion of the case studies would prepare students to use instruments during the Power Lab. An additional advantage to Power Labs would be the possibility of combining

laboratory activities to focus on a specific question rather than as a series of discreet and unrelated exercises typical of a once a week three hour lab. At many universities, teaching labs are not as heavily used during the summer months. In addition, many universities provide dormitory rooms and meal plans for short stays during the summer in support of camps and other activities. The availability of lab space and inexpensive housing would make many universities ideal locations for the delivery of Power Labs.

3. Online Science and Instrumentation Centers

One way to facilitate moving labs online will be through the development of regional centers that provide an online laboratory experience. These centers would most likely be located at an established college or university and would provide online and face to face laboratory experiences. The centers would specialize in the creation of online labs, virtual simulations and development of supporting curricular materials. They would also provide remote access to instrumentation and would be capable of delivering Power Labs. Online labs developed by the centers could be used by institutions providing online degree programs in the sciences. In this way, distance education programs could focus on the online course content which would then be supplemented with online or Power Labs developed by the centers. Each distance education program could then decide the laboratory experience, either online or through Power Labs, that would be required for their students. These centers could be supported, in part, through the use of lab fees charged as part of the course.

II. DISCUSSION

The online environment is just now starting to make an impact on the traditional laboratory-based sciences. Discussions from the Moving the Laboratory Online workshops have shown a significant interest in online labs across many disciplines. They have also shown that a community of interest and practice is beginning to form and gain experience in developing and delivering online laboratories. Experience has shown that moving labs online is indeed possible and effective; however, doing so comes with the cost of rethinking the role of labs within the curriculum. The online environment cannot and should not be used to try and replicate the traditional face to face laboratory. Instead, the development of online labs should focus on defining and developing the laboratory experience to provide the knowledge, skills and values necessary for students to become scientifically literate and technically competent individuals.

Online labs will continue to gain acceptance as legitimate alternatives to the face to face laboratory experience. As online resources continue to be developed, the quality, quantity, and diversity of online lab offerings will also expand. In addition, blended labs will continue to evolve and will incorporate many of the tools available within the online teaching community.

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IV. ACKNOWLEDGEMENTS

The authors would like to thank Sloan-C, in particular Kathleen Ives and Jonathan Small for producing the Moving the Labs Online workshops. We would also like to thank the participants for their thoughtful discussions. Funding from the National Science Foundations Course, Curriculum, and Laboratory Improvement Program (DUE # 0618626) is gratefully acknowledged.

EVALUATING THE BENEFITS OF PROVIDING ARCHIVED ONLINE LECTURES TO IN-CLASS MATH STUDENTS

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ABSTRACT
The present study examines the impact of a novel online video lecture archiving system on in-class students enrolled in traditional math courses at a mid-sized, primarily undergraduate, university in the West. The archiving system allows in-class students web access to complete video recordings of the actual classroom lectures, and sometimes of lecture notes, shortly after the in-class sessions are completed. The data collection for evaluating the impact of this archiving system was designed through focus groups, and consequently, obtained using a customized web survey. Survey questions targeted areas of potential impact such as: changes in attitudes and behaviors (such as study habits), changes in the dynamics of professor-student relationship, and the overall student performance enhancement. The results indicate that the presence of the archived video lectures and lecture notes adds significant value to the learning process with notable improvements in the perceived student performance and overall experience in the class.

KEYWORDS
Supplemental Instructional Materials, Online Archives, Student Achievement, Performance Assessment

I. INTRODUCTION

The past few decades have seen compelling increases in the use of technologies in education in general and the teaching of mathematics in particular. Many such practices can be seen in the literature, from the early use of cable and satellite "narrow-casting" of classes [1], and the use of student centered, computer assisted instruction [2], to the more contemporary practices of blended education and web-based courses [3, 4, 5, 6]. The present study introduces a logical and natural extension of these heuristic endeavors by focusing on the use of novel methods of web archiving, such as video recordings, to supplement and/or substitute for in-class presentations of both upper and lower division traditional courses in mathematics.

Since 1998, the *MathOnline* program at The University of Colorado at Colorado Springs (UCCS) has been successfully offering online archives of several UCCS mathematics courses. These are hybrid courses, with enrollments both in-class and online, and the actual in-class lectures are being streamed live and archived for asynchronous viewing. The primary focus has been delivering math content to remote students who could not attend regular classes at UCCS, such as math-advanced high school students, military personnel, and others. A byproduct of this program was that traditional (in-class) UCCS students were also given access to the archived courses for asynchronous viewing. Preliminary data collected in the past for gauging the impact of the availability of such material to the in-class students has been

encouragingly positive [3]. In 2005, it was theorized that the archival system would in fact be a valuable teaching aid for both hybrid courses and traditional on-campus mathematics courses. As a consequence, the use of archived lectures was expanded to include traditional courses that were not part of the *MathOnline* program. For traditional courses, with no remote (online) students, the UCCS Department of Mathematics designed and implemented a novel lecture archiving system, with full video recording of the actual classroom presentation. Since Fall 2005, it began offering archives of video lectures for several non-*MathOnline* courses (mostly upper level undergraduate and graduate courses), as well as for selected *MathOnline* courses. As of the end of the academic year 2007–2008, more than thirty courses have been archived and are now available freely on our website http://www.uccs.edu/math/video.

II. MOTIVATION AND GOALS

This study analyzes the benefits to UCCS students of providing online video lecture archives of selected math courses. The students enrolled in such courses can access the recording of their most recent lectures within hours of the completion of the class session, and they can also access past lectures from their courses as well as from other related courses, such as prerequisite courses. It was hypothesized that the potential for archived lectures was a largely overlooked and relatively simple resource that would enhance learning for math students. The primary concern of this study was to address the question, "How does access to course lecture archives impact students' learning and performance in the course?"

Prior to launching this targeted study in Spring 2007, several instructors (including the first named author) noted that the offering of video archives provide several benefits toward improving student performance (see also [7, 8]). The benefits are especially evident in advanced undergraduate and beginning graduate courses (which at UCCS are often cross-listed), where students are normally exposed to novel types of thinking and reasoning compared with previous courses. An example is the Mathematical Modeling course, the capstone course for all math majors at UCCS. Here, students are exposed to advanced computational techniques, while theoretical skills learned in previous courses are put to work in modeling real world applications. The archived lectures seem to help students grasp the novel approaches taught in this class, by giving them the opportunity to replay (all or parts of) the lectures in this course as well as in previous courses containing prerequisite concepts. Another example is the Modern Analysis course, where the increased level of abstraction usually marks a significant change from the material presented in previous courses. The availability of the archived lecture materials allowed many students to revisit portions of previous lectures, to clarify concepts discussed in class, and to review the material for upcoming exams. It was also found to be useful for students who had to miss a lecture, allowing such students to remain current with the course material.

Specific goals of our study emerged during focus groups conducted in April 2007. Two groups of students, one for lower division courses and one for upper division courses were asked for their perceptions of the archived lectures. The focus group sessions were conducted without direct participation of any math faculty, and the discussions were compiled and kept anonymously from the principal investigators in the Math department, so that students would not be inhibited to express their true opinions about all aspects of the archiving system. Based on these discussions, the web survey questions (described below) were designed.

One deciding factor in initiating this evaluation has been the observation that few universities have embraced similar technologies in their regularly offered math courses. A search on the web indicates that, as of Spring 2007, several other universities offer free course archives, but the math offering in such archives is very limited. Notable examples are Stanford University, University of California at Berkeley, MIT, and Yale University. Some universities have created online archives specifically for math courses,

such as North Carolina State University; however, unlike our approach, the format of the classroom being archived seems to have been altered to accommodate the archiving tools. It is important to mention at this point that the UCCS Math archiving system has been deployed with minimum disruption to the traditional classroom setting via whiteboard lectures and hand-written notes. This system, we believe, allows for a better assessment of the benefits of the archives to student learning without any compromise to the otherwise essential classroom student-teacher interaction. Consequently, the present study relies on a traditional classroom format with essentially no change to teaching heuristics and methods.

III. PROGRAM DESCRIPTION

The UCCS archiving system is comprised of two distinct archival methods, both designed to offer web access to lectures, either synchronously, primarily for remote students, or asynchronously, shortly after they are delivered in class, for the in-class students and remote students (if any). Since this study focuses on the in-class population, we will emphasize the asynchronous aspects of these methods.

The first method, used primarily for hybrid courses since 1998, requires a smart classroom (with a permanently installed LCD projector), and consists of a screen capture system (currently iLinc), in which the instructor utilizes an input device such as a Wacom tablet or a tablet PC. The computer screen is projected on a large, front-of-classroom screen, so in-class students can see the instructor's screen. In addition, the image with audio is simultaneously captured, streamed live and later archived. Depending on the frames per second (fps) rate and the audio compression settings, the file size can reach as little as 10 MB/1 hour of lecture, making it suitable for downloads over dial-up/modem connections.

The second archiving method, introduced in Fall 2005 for both hybrid and traditional courses, consists of videotaping a regular classroom presentation, then compressing it using QuickTime broadcaster in H.264 format (640x360 widescreen) with 15 fps rate and 450 key frame rate. The data bit rate is limited to 400kbs and frame reordering is enabled. The actual compression rarely exceeds 200kbs, and achieves a good video quality, thus resulting in a relatively small file size (~100MB/1 hour of lecture), suitable for downloads over high-speed (Cable/DSL) Internet connections. The compression can be done either live, whenever the camera can be connected to a computer during the lecture, or after the lecture. Time of compression is 1XT. Post-processing is minimal and can be done within minutes using QuickTime Pro software. The instructor can use the usual chalkboard, or, if the room setup includes a LCD projector, can use an electronic input device (such as a tablet PC), in which case lecture notes can be made available immediately after class.

The main cost incurred in creating the video or iLinc lectures for a course consists of hourly wages, usually at the student worker rate, for monitoring the recording (audio/video) session. Post processing and organizing the web archive requires minimal work and can be accomplished within minutes from the end of the actual lecture.

It is important to emphasize that archiving methods do not change the classroom format, and that the presence of the archiving tools is not intrusive. As our survey indicates, in-class students are able to ignore the added features and concentrate on the in-class presentation, as they would in any other traditional classroom. The population of interest in the present study was restricted to in-class students, who only use the archives asynchronously, but it is worth noting that both methods of archiving also allow for synchronous viewing, with the latter method offering remote students the choice of participating interactively. Such interactions would also be recorded for subsequent asynchronous viewing and would become part of the archives that student could watch.

Throughout the semester, the archived materials for each course (video, iLinc and/or notes) were uploaded, organized and posted on a webpage, where students can go (upon free registration) to access them. One course (Calculus III) also featured podcasting and RSS feeds on an experimental basis, mostly for convenience.

IV. METHOD

A. Participants

All students enrolled in seven Math courses during Spring 2007 were initially contacted by e-mail about participating in the survey. Three courses were hybrid (*MathOnline*) undergraduate courses (Calculus II, Calculus III, Number Theory) and used the iLinc method of archiving lectures. One of these hybrid courses offered full video format in addition to the iLinc recording. The remaining four courses were traditional math courses offered at the senior undergraduate/beginning graduate level (Mathematical Modeling, Modern Analysis II, Scientific Computation and Mathematical Statistics II) and used the video archiving method. Two of these traditional courses also offered lecture notes archiving in addition to the video lectures. A total of six instructors taught the seven courses considered in this study.

The total cumulative enrollment for the seven courses featuring the archiving system was 158, with only 11 (upper division) students being enrolled in two courses simultaneously. Hence only 147 email invitations to participate in the survey were sent out. As part of the recruitment effort, potential participants were advised that a $20 bookstore certificate would be awarded to three randomly selected students who completed the survey.

Of the 147 students contacted, 51 completed the survey. Participants were asked to complete the *Archived Math Survey* basing their responses on the archived class for which they were enrolled in the spring semester of 2007. Students who were enrolled in more than one course being archived were asked to pick one of the courses they were enrolled in and answer all survey questions based on that course. Of the students who responded to our survey, 25% were enrolled in a mathematics course with full video-recordings, 51% — with iLinc presentation, and 20% — both video and iLinc; 4% did not respond. Of the participants, 59% were male and 37% were female (4% of participants did not report their gender). Participants consisted of 39% math majors, 57% non-math majors (i.e., Engineering, Biology, Computer Science, Physics, Chemistry, Other), and 4% did not report their major.

B. Materials

In addition to demographic information, participants' usage of and satisfaction with the mathematics archival system was assessed using a 20-item scale (see Appendix A) that included items designed to assess attitudes (e.g., *I like being able to revisit the material in the archives repeatedly*), behaviors (e.g., *I use the archived lectures to verify what my professor has said*), and ease of using the system (e.g., *I am distracted by the recording procedures*). Responses were measured on an 8-point Likert scale from 1 (strongly disagree) to 8 (strongly agree); four items were reverse-scored.

C. Procedure

Students who were enrolled in an archived mathematics course in the spring semester of 2007 were emailed an invitation to participate in an online survey assessing their attitudes toward and usage of the system. A link was supplied in the email that redirected them to a site containing an informed consent

form, a 40-item survey, and demographic questions. Only those who chose '*I agree to participate*' proceeded to the survey and demographic questions; those who did not agree to participate were directed to a page thanking them and redirecting them to the mathematics department website. Fifty-nine students responded and eight declined to participate.

A reliability assessment was conducted on the 40-item scale revealing a Cronbach's alpha coefficient of .83. As an exploratory procedure, a principal components factor analysis was conducted on the 40 items, forcing a single component solution, revealing an eigenvalue explaining 15% of the variance. Using the results of this analysis and the Cronbach's alpha analysis, we removed twenty of the items, resulting in a unidimensional scale accounting for slightly over 40% of the variance and a Cronbach's alpha of .92. Table 1 depicts the item correlations, Cronbach's alpha if the item was deleted, and the factor loadings.

V. RESULTS

Twenty Likert questions assessed the participant's satisfaction and usage of the archived mathematics system using an 8-point response scale. Low scores indicate a negative experience or attitude and high scores indicate satisfaction and positive experiences in using the system (four items were reverse scored, see Appendix A). Preliminary analyses were performed to ensure there were no violations of normality, linearity and homoscedasticity. One-Sample t-tests were conducted on each item as well as on the overall scale mean to determine if there were significant differences between the participant's responses and the mid-point of the scale, 4.5, which would indicate neither satisfaction, nor dissatisfaction with the archival system. The overall mean, (M = 5.81, SD = 1.17) was significantly different from 4.5, $t(50) = 7.98$, $p < .01$, and indicates that participants rated the archives positively, as indicated by a mean significantly higher than the disagree-agree scale midpoint (see Table 1). Responses per item also indicate significantly higher-than-average satisfaction scores for all items except two, for which responses were consistent with neither liking nor disliking the archival system.

A one-way ANOVA was conducted to determine if there were differences in overall satisfaction of the archival system between males (M = 5.63, SD = 1.26) and females (M = 6.10, SD = .98). There were no significant differences found, F (1, 48) = 1.54, $p > .05$. A one-way ANOVA was also conducted on overall satisfaction of the archival system and whether the participant was a mathematics major (M = 5.83, SD = 1.37) or a non-mathematics major (M = 5.78, SD = 1.03). No significant differences were found between these groups, F (1, 48) = 0.02, $p > .05$.

The relationship between overall satisfaction with the archival system and the grade each participant received in the archived class for which he or she was responding was investigated using a one-way ANOVA with four levels (grade received: A, B, C, D/F). There were no significant differences between groups, F (3, 48) = 1.36, $p > .05$. Therefore, the grade a participant received did not significantly impact satisfaction with the archived system.

The relationships between overall satisfaction of the archived system, age, and number of math classes taken were investigated using Pearson product-moment correlation coefficient. There were no relationships found between the three variables, indicating that neither the participant's age (r = -.107, n = 51, $p > .05$), nor the number of math classes taken (r = -.11, n = 51, $p > .05$) had an impact on overall satisfaction with the archival system.

Significant correlations were found between total satisfaction with the archived system and the overall difficulty of the class (r = -.28), the grade received (r = .28), and the grade expected had the class not

been archived (r = -.28). This indicates convergent validity: the more difficult the class was perceived to be, the more positively respondents rated the archived system; the higher the grade received, the more satisfied the respondents were with the archived system; and the higher the total satisfaction rating, the lower the expected grade had the class been offered without access to the archived system.

Table 1. Item Analysis and Internal Reliability for the Spring 2007 Math Survey (N = 51)

Item	*M*	*SD*	*r*	α without item	factor loading
1. I like being able to revisit the material in the archives repeatedly.	6.39*	1.96	.76	.91	.81
2. I use the archived lectures to help with homework.	5.63*	2.38	.60	.91	.67
3. I think the image quality of the archived lectures is good.	5.65*	1.43	.48	.92	.52
4. The archives help me understand complex concepts.	5.63*	1.78	.61	.91	.70
5. I use the archived lectures to verify what my professor has said.	5.45*	2.08	.51	.92	.40
6. I use the archived lecture to review for exams.	5.78*	1.90	.71	.91	.57
7. I can listen more in my archived class(es) than in my non-archived classes.	4.22	2.11	.53	.92	.76
8. I use the archives to supplement study.	5.43*	2.00	.62	.91	.60
9. I like the archived lectures because I can skip material I already understand.	5.22*	2.00	.37	.92	.67
10. I like the idea of being able to see both the professor and what is being written.	6.04*	1.70	.41	.92	.43
11. Given a choice between a section of a class with archived lectures or without, I would choose the archived section.	6.22*	2.00	.70	.91	.44
12. The archives are useful to me for providing information missed in class.	6.69*	1.29	.55	.92	.74
13. I think all my math classes should be archived.	6.69*	1.64	.64	.91	.59
14. I like being able to hear the material repeatedly in the archives.	5.94*	1.99	.82	.91	.69
15. I spend more time studying when archived lectures are available, than when they are not.	4.51	2.27	.67	.91	.86
16. I have learned more than I would have had I not had access to the archived lectures.	5.82*	1.89	.61	.91	.72
17. If I didn't get the concept in class, seeing the same presentation again doesn't help. (R)	6.16*	1.62	.46	.92	.66
18. I would rather borrow notes from someone than use the archives(R)	6.45*	1.78	.49	.92	.60
19. I am distracted by the recording procedures. (R)	7.06*	1.35	.38	.92	.54
20. It is difficult for me to pay attention to the archived lectures. (R)	5.16*	1.83	.55	.91	.49

* Significantly different from the scale mid-point of 4.5 at an alpha level of .05; (R) Reverse scored items.

In addition to the survey questions above, participants were asked to supply (voluntarily) the grade received in this class. Of the respondents, 27% received an A, 31% received a B, 18% received a C, and 20% received a D or lower. 4% of participants did not supply their grade. A majority of participants (84%) rated their class as difficult to very difficult, and 51% of the respondents believed that their grade would have been lower had the class not been archived.

A subsequent analysis of the use of the archives was conducted using the number of accesses stored by the server. For the upper division courses, where the total enrollment was 59 enrolled students (out of the 149 invited to participate), this analysis revealed that all (100%) of these upper division students visited their respective course archives at least once during the semester, and they visited the archives on average 15.4 times during the semester. No data was collected on how many video lectures these students downloaded or watched during each visit, but it is plausible that they accessed more than one lecture. Also, no data was collected of the time during the semester the visits occurred, but anecdotal evidence indicated that the archived lectures were more in demand prior to exams or quizzes. This evidence is based, for example, on the number of complaints received right before an exam, complaints generated by instances when the server was slower in serving the lectures, or when certain lectures were posted with some delay. Similar data was collected for one of the lower division courses (Multivariable Calculus), revealing a somewhat different usage pattern. Out of the 35 students who completed the class, only 24 of them (or 68%) utilized the web archive at least once in the semester, with an average visit count of 14.58 times per student.

The figure below illustrates data collected for two representative courses (Multivariable Calculus and Mathematical Modeling courses), which had the highest enrollment in each of the division and which were taught by the same instructor. Individual grades are plotted against the usage during the semester for all students enrolled in both courses.

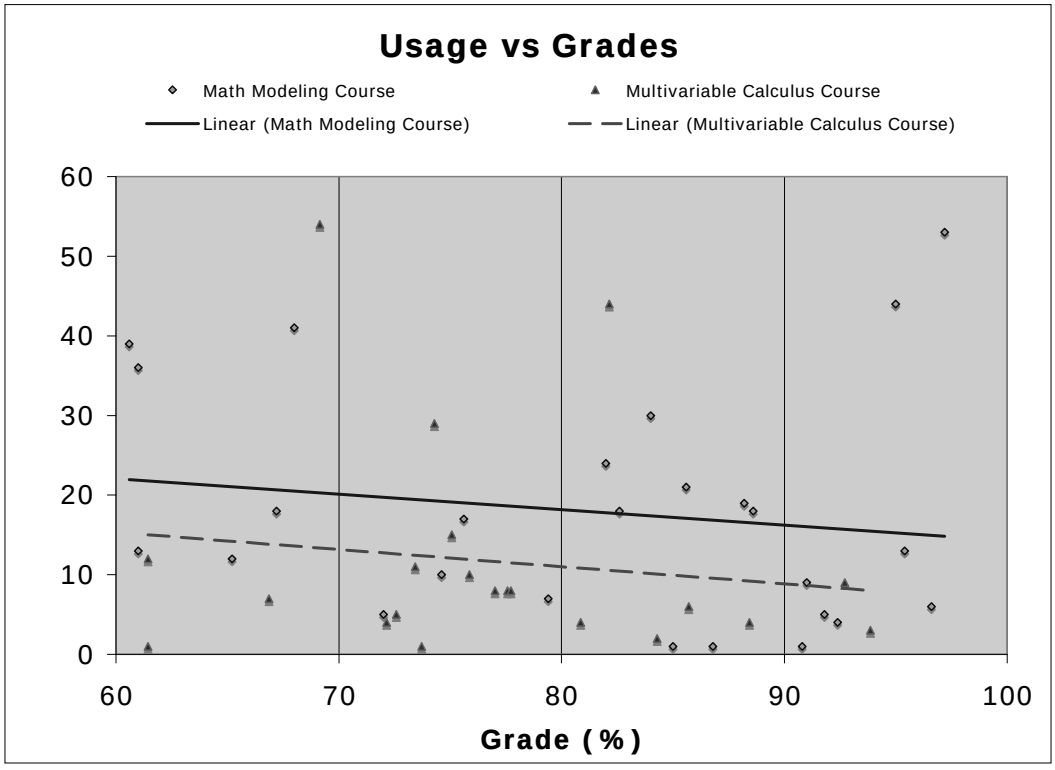

Figure 1. Data Representing the Usage (Number of Hits) for Each Student Who Completed at Least 60% of the Work Vs Their Grades (%) in the Course. Two Representative Courses are Illustrated, One Lower Division (Multivariable Calculus, Enrollment = 34) and One Upper Division (Math Modeling, Enrollment = 29).

A regression line for each set of data reveals a similar pattern for both courses, with slightly higher usage among students who received a lower score in the course versus students who received a higher score. It is also worth noting the higher overall usage in the upper division class (regression line shifted upward)

versus the lower division class, which could indicate the difficulty level of the class and the presumptive higher overall utilization of the archives in such courses. Since the actual responders to the survey remained anonymous to the principal investigators of this study, it has been impossible to isolate only the data indicating the usage of the archives among the actual responders to the survey. It is only from the grades reported (voluntarily) by the survey participants that one could draw conclusions as to whether only students who used the archive more heavily actually chose to respond to the survey or not. Despite the intrinsic value of such conclusions, the authors decided to leave this kind of analysis as the subject of a future study.

VI. DISCUSSION

The online archiving of university level courses seems still in its infancy, especially in technical fields such as mathematics, where the traditional classroom setting seems to be the most widely used method of instruction. Online archiving has already proven to be an emerging learning tool, essential in the diverse student community of universities such as UCCS, and its benefits are not limited to distance learning. Informal observations on the beneficial aspects of this archiving process, made by instructors in courses that offered it in the past, have been confirmed in this formal study.

This study focused on the impact of the course lecture archives on students' learning and performance in the course. The data was collected from students enrolled in several courses, with different level of difficulty (both lower division and upper division) and taught by several instructors. The cumulative data indicates that the presence of the archived video lectures and lecture notes adds significant value to the learning process with notable improvements in the perceived student performance and overall experience in the class. This conclusion seems to hold true regardless of the course level and of the particular teaching style of the instructor.

We envision that archiving will soon be a standard tool that universities will be expected to showcase to successfully attract and retain students, and that further studies such as ours will prove to be instrumental in administrative decisions to implement this on a larger scale at many universities. In our limited deployment of the video archiving system, it has already been documented that instructors can accommodate such technologies with minimum or no effort and that more and more instructors are willing to embark on this enterprise, in order to provide students with supplemental materials that prove to be useful to a majority (if not all) of their students. Several techniques of maintaining or even improving attendance have been suggested, such as administering frequent in-class quizzes or delaying the posting of the archived lectures. In the courses relevant to this study, the attendance did not seem to be affected by the presence of our archiving system, indicating that there were no significant negative changes in student attitudes and behaviors. Our experience showed that a drop in attendance due to the presence of archived lectures was not a major reason of concern but that the instructors themselves can easily implement such measures if needed. Nevertheless, a more careful analysis of this aspect should be conducted in future studies. At the same time, further studies into the effects of this new technology on enrollment and retention rates would support the broader implementation of such archiving systems.

While the investigators are striving to optimize the efficacy of the archived process and assessment tools, it is already our belief that studies such as ours are at the forefront of research in teaching and learning. We anticipate that the results of the present study are relevant to other disciplines and other university communities interested in openly sharing their knowledge via the web. The results of this study may encourage other math departments to adopt similar technology and share their courses online with other universities. This open cooperation between departments in the same field of study would be especially advantageous to those with limited course offerings, particularly in small graduate and Ph.D. programs.

Because of the low cost nature of the video technology involved, other departments may find it perfectly suitable for their regularly offered courses (such as in humanities, science and engineering fields). This in turn will likely create the demand for the infrastructure needed to support individual departments within a larger scale deployment of this technology throughout the university campus.

The overwhelmingly positive feedback from students with no differences detected for the demographic variables of interests of study, ages, and gender indicate that the archival system employed in the present study, and those that are similarly designed, have universal appeal and effectiveness as an educational supplement.

VII. ACKNOWLEDGEMENT

The authors acknowledge the support of the 2006–2007 University of Colorado President's Teaching and Learning Collaborative (PTLC) and the UCCS Student Achievement Assessment Committee (SAAC). The authors express their gratitude to the external reviewers for the comments that helped improve the exposition of this article.

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IX. APPENDIX A
SPRING 2007 MATHEMATICS ARCHIVED LECTURE WEB SURVEY

The following statements are designed to assess your opinions regarding the archived math lectures. Please answer for the archived math class you completed in Spring 2007. If you were enrolled in more than one archived math class, choose ONE and ANSWER THE FOLLOWING QUESTIONS FOR THAT CLASS. For each item, please choose the number that corresponds most closely to your opinion. Please read each item carefully, and answer all questions. THERE ARE NO WRONG ANSWERS!

strongly disagree	2	3	4	5	6	7	strongly agree

1. I like being able to revisit the material in the archives repeatedly.
2. I use the archived lectures to help with homework.
3. I think the image quality of the archived lectures is good.
4. The archives help me understand complex concepts.
5. I use the archived lectures to verify what my professor has said.
6. I use the archived lecture to review for exams.
7. I can listen more in my archived class(es) than in my non-archived classes.
8. I use the archives to supplement study.
9. I like the archived lectures because I can skip material I already understand.
10. I like the idea of being able to see both the professor and what is being written.
11. Given a choice between a section of a class with archived lectures or without, I would choose the archived section.
12. The archives are useful to me for providing information missed in class.
13. I think all my math classes should be archived.
14. I like being able to hear the material repeatedly in the archives.
15. I spend more time studying when archived lectures are available, than when they are not.
16. I have learned more than I would have had I not had access to the archived lectures.
17. If I didn't get the concept in class, seeing the same presentation again doesn't help. (R)
18. I would rather borrow notes from someone than use the archives. (R)
19. I am distracted by the recording procedures. (R)
20. It is difficult for me to pay attention to the archived lectures. (R)

(R) Reverse scored item.

STUDENT ISSUES IN DISTANCE EDUCATION PROGRAMS: DO INTER-INSTITUTIONAL PROGRAMS OFFER STUDENTS MORE CONFUSION OR MORE OPPORTUNITIES?

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ABSTRACT

The Community Development Master's Program is an inter-institutional, trans-disciplinary degree program that began in 2005 online at five participating universities in the North Central region. This article discusses outcomes of interviews with current and past students in the program to determine if a multi-institutional program, versus a program run by one university, makes for more or different struggles and/or opportunities for the online learner. Sloan-C's five pillars for online learning are used to frame the findings. Through qualitative data collection and analysis, researchers in this study worked to find out if having more institutions involved in a distance education program caused students to leave the program, or if it measured up similarly to online programs offered by one university, in terms of student challenges.

KEYWORDS

Inter-institutional, Five Pillars, Retention, Student Success, Drop outs

I. INTRODUCTION

More and more students in recent years have decided to continue their education through online master's programs. Students choose these programs because they can maintain their careers and family life, as many are unable to move to a university campus for three or more years. Students also like the flexibility and convenience that an online program offers [1, 2]. Wilde and Epperson [3] found that "The ability to remain employed, study after hours, and maintain family and community relationships relatively undisturbed all prove to be powerful reasons for choosing distance programs." Online programs, up until recently, have been offered by one university through one form of teaching technology such as WebCT and BlackBoard. However, many institutions find that scarce resources and instructors make collaborating with other institutions to fill gaps in the curriculum and faculty a necessity. Students who enroll in an inter-institutional degree program take courses from multiple universities in several different formats, including various technological interfaces and use of audio and video technology within the courses. Students in the Community Development Online Master's Program use Web CT, Blackboard and K-State Online throughout their course of study in the program; sometimes they are using all three in one semester. As more universities decide to offer collaborative degree programs, we wanted to explore how taking online courses from multiple universities impacts students' experiences and success as well as recruitment and retention. To explore these, we utilized the Sloan Consortium's five pillars of quality for online education: learning effectiveness, cost effectiveness and institutional commitment, access, faculty satisfaction and student satisfaction [4]. Inter-institutional programs working together to meet these pillars of quality share resources, yet each institution presents a different face to the students. One might expect that the need to interact with different institutions, registrar offices, and technology would create additional barriers for the online student. This paper presents the results of the research on student success

in a multi-institutional context by reporting on the experiences of students enrolled in an online transdisciplinary, inter-institutional master's program in Community Development to determine if the multi-institutional context impacts students' experiences within the five pillars.

II. BACKGROUND OF THE PROGRAM

Michael and Balraj [5] discuss the main reasons why institutions engage in inter-institutional degree programs: "Primarily, institutions establish joint degrees to (1) meet the need of a changing profession, (2) restructure degree programs to become more interdisciplinary, (3) respond to enrollment needs, and (4) enhance the specialization nature of some degree programs." For these reasons an inter-institutional degree program makes sense; these programs allow institutions to provide programs that may otherwise not exist. The authors also cite that there are some disadvantages, in so far as students switching between sites and the approval process within all of the universities. In the Community Development program it has been challenging to gain approval at all of the universities within the same timeframe, but that did not mean the program could not run. Students simply could not enroll in an institution that was not approved; however, this has not slowed down enrollment. Students are willing to enroll in a partner institution. Additionally, our study did not show that students had difficulty switching between sites online. They may have preferred one interface over another, but they did not cite this as a reason for leaving the program.

Moxley [6] points out that "Inter-institutional distance education program alliances enable collaborating universities to deliver online academic programs that capitalize on their collective technological and human capacities." The Community Development Online Master's Program is an asynchronous degree program offered through the Great Plains IDEA (Interactive_Distance Learning Alliance). It is not a collaborative degree only because it involves several universities; it also involves several different disciplines. Faculty from Planning, Architecture, Sociology, Economics, Native American Studies, Natural Resources, Communications, and Agriculture all offer courses in the program. The program officially began in Fall 2005 with courses offered by Iowa State University, South Dakota State University, and the University of Nebraska. At the time the student interviews were conducted, the program was not yet approved at North Dakota State University, Kansas State University, or the University of Missouri, but courses were officially offered in all these institutions by Spring 07. With the help of a USDA Higher Education Challenge Grant, The North Central Regional Center for Rural Development, housed at Iowa State University, provides day-to-day management and leadership of the program. The program started primarily to "meet the needs of a changing profession," as well as to enhance programs already in place. At the time of its inception, it was the only online Master's Degree in Community Development available; all others we studied required some sort of residency. The program offered two courses in the Fall and two in the Spring of 2006. In Spring 06 we conducted interviews with current and former students in the Spring of 2006 to investigate their viewpoint of the program and to better understand the program's progress. Current students included those who either were formally enrolled in the program through one of the universities or those enrolled in one or more courses, but did not formally enrolled in the degree program. Former students either decided to drop courses, drop the program, or end their coursework because they had supplemented an already existing Program of Study with some of Community Development program's courses and did not intend to take more courses.

III. RESEARCH ON DISTANCE EDUCATION: FACTORS THAT AFFECT STUDENT RETENTION

Research on distance education programs suggests that students who learn from a distance enroll and drop courses for many of the same reasons: family commitments, jobs, time, and technology; all of these

elements make distance education attractive, but also cause students to become overwhelmed and drop out. Additionally, students who succeed in distance education programs create ways to make it work for them, mainly through coordinating their schedules and surrounding themselves with supportive people. The purpose of this literature review is to find out why students leave distance programs offered by one institution and if they leave for reasons that relate to the reasons for attrition in our multi-institutional program.

Piercy and Lee [9] found that students in a graduate distance program in family relations offered through Utah State University appreciated the flexibility and freedom the program provided them. Students thought the instructors were very competent and found the material in the program led to the enhancement of critical thinking skills. Downfalls of the program included a lack of information about the program from the very beginning and a need for more mentoring. Students wanted a bit more flexibility in their coursework in terms of choosing more electives. They also wanted more ease in gaining library materials from the university. The authors also discussed how interested students ended up not enrolling because of family situations, change in career, or other educational opportunities. Distance students appreciate the ability to continue to work and maintain their obligations in the community and in their family while gaining a master's degree.

Retention in distance education programs remains a significant challenge, as Piercy and Lee [9] point out. They offer several strategies for improving retention, including frequent communication and peer mentoring, as well as making sure information is passing back and forth in a fluid motion. There are seemingly many factors when it comes to retention. Nash [10] focuses on why many distance students end up dropping out of a program of study. He cites several factors that lead to dropping out of a program with time being a leading factor, as well as lack of preparation for the curriculum, lack of support, and difficult in contacting faculty. Garland [11] found that students often cite the lack of time as a reason for dropping out of a distance education program. However, she also discusses that this can often be "a simplified explanation of the difficulties they were experiencing." She found this to be true with other reasons students cited as well; even when students said they did not have enough money, there were usually other reasons why the students dropped, such as "a lack of prerequisite knowledge, [and] lack of peer and family support…"

As Valenta et al. [1] points out, cost is an issue for some students [12]. Some students feel that they should be provided financial assistance from the institution to pay for equipment and Internet charges. Access can also be difficult for some students who do not have the right equipment and technology. Lao and Gonzales [13] cite discussion from one of their students who said that not having the right version of an Internet browser can make or break a class. Many students in the Community Development program live and work in rural settings, and rural populations often face challenges with accessing high-speed Internet [14]. Lack of high-speed access can also be a barrier to success in online programs.

Pierrakeas, et al. [15] found that students were dropping out of a Greek graduate distance education course because of personal reasons, professional reasons, misunderstanding of academic rigor, lack of interest and lack of time. Much like our study, they found that non-traditional graduate students who had been away from school for a long period of time had a difficult time readjusting to the rigor of graduate coursework. Likewise, these students found it difficult to balance their professional, family and academic lives. Williams, et al. [16] cite Powell, et al.'s [17] classification of factors related to success and retention: Predisposing characteristics, life changes, and institutional reasons. These factors directly connect to what we heard from our students.

Atack [18] found through a study of nursing students taking online coursework, students new to online learning can find it somewhat intimidating and that the learning curve can be high. Learning how to be a student in a graduate program as well as how to use online learning technology proved difficult for some of the students in Atack's study. She also found that communication over technology can sometimes be an obstacle and create problems for students. This was the case for the Community Development students; additionally, we found that some obstacles in students' lives go far beyond the technology.

When it comes to student learning online, the literature points to the importance of promoting strong collaboration and communication in the class [19, 20, 21, 22] Fung focuses on the difficulty in facilitating genuine discussion in online classrooms, because students sometimes do not have the time it takes to post a thoughtful comment. Or, students lose interest in the conversation, but post a comment simply to gain credit. This can be a vicious cycle in class discussion; Haythornthwaite [21] offers several recommendations for improving and facilitating online collaboration. It is important for online instructors to create a positive forum for discussion so that students do not "disappear" from the discussion and ultimately drop out of sight. Students, in turn, get more from the course if they are engaged in the material with their instructor and peers. Further, Lao and Gonzales [13] discuss the need to respond to students in a timely manner, "in spite of the amount of work that is required when writing this feedback."

From scanning the literature on online education, it seems that the issues are very much the same in all programs offered through one institution or many. Students like the flexibility of distance education, but they do not always anticipate the time needed for coursework. Students sometimes find technology to be a barrier to learning online, if they are new to it or have outdated technology or limited access. And, retention in distance education is an issue because the student population often includes non-traditional students who are older and have full-time jobs and family commitments.

From the review of the literature, we understand that students within our inter-institutional program struggle with many of the same issues as students mentioned in the research. Students in our program did not cite that the multiple institutions and technological interfaces created stumbling blocks. They cited the same reasons in the existing literature. Therefore, we moved on to our findings, which suggest that retention issues closely relate to the issues that have already existed.

IV. PURPOSE OF THE EVALUATION

We developed the evaluation process primarily to learn why some students succeeded in the program while others dropped out. We felt some kind of person-to-person follow up was necessary because distance students in any online program do not have face-to-face access to instructors or advisors, and thus key issues may escape faculty notice. Research indicates that these issues often impede a student's progress and contribute to a spiral of non-attendance leading to failure. Because many students may not be comfortable with bringing such issues up in class, they may not be discovered until after a student drops the course or program, making it too late to "fix" the problems. To understand the issues that students faced in the Community Development program, we solicited their opinions about the different facets of the program including the inter-institutional context, the various approaches to technology, the faculty roles, the coursework, the time needed for successful completion, their support network, and finances. Additionally, we wanted to learn from the successful students the techniques and habits they employ to make online learning in an inter-institutional program work for them.

This evaluation process was particularly important for us because once the program began, student retention quickly became a dominant concern, and despite efforts to connect with each student, we still

had many "drops" by the end of the first semester (see Table 1). In particular we wanted to determine if the inter-institutional online master's program created too much confusion for students and thus influenced their decision to drop out. Perhaps offering the program from more than one institution was not working. After carefully reviewing the literature on online degree programs and interviewing current and past students, we found that students' experiences in this inter-institutional online program closely mirrored those of students participating in online programs offered by a single university, in that students were citing the same difficulties: time management, finances, course difficulty, and life changes.

Table 1: Student Retention Numbers

	Number of students beginning in combined courses	Number of Students dropped course or program altogether
Semester 1 Fall 2005	22	12
Semester 2 Spring 2006	17	8

In designing an appropriate evaluation process, we determined to use the positive deviance methodology with successful students. Based on the Appreciative Inquiry approach, the positive deviance methodology focuses on learning what is working well by studying the patterns, attitudes, and actions of those who are successful [7]. Using Appreciative Inquiry provide us with a lens through which we could view the student's perceptions from a systemic perspective; it provided us with a method for looking at student situations from a holistic viewpoint [8]. We also applied Appreciative Inquiry techniques to the interviews with students who dropped, soliciting from them the things that had worked well for them and asking them to tell us what would need to happen for the program to have worked better for them.

V. EVALUATION INSTRUMENTS

For the purpose of this evaluation, we developed two different instruments. One instrument includes a list of questions for current students, and the other includes a list of questions for past students who either dropped a course or the program (Box 1 and 2). An asset-based approach was used to design the questions. Instead of focusing on problems, questions were created around the strengths, opportunities, and possibilities of the program. Students were contacted about what was going well and the opportunities they saw for the future. We also asked them to give us three wishes for the program.

We developed specific questions about the program from student feedback over email and with instructors, program managers and campus coordinators, as well as from conversations in faculty meeting conference calls. In total, we collected responses from 20 current and former students over the course of a few months. If students were unreachable by phone, we immediately sent email messages, and students filled out the questionnaire and sent it back. We also sent the questionnaire by email if students were unable to find time for a phone interview. After three attempts to reach unresponsive students, we did not pursue them any further. There were five students who were not interviewed and did not fill out questionnaires because they did not return phone calls or email messages. Reasons for the lack of communication are unknown except in one case where the student had health problems; however, reasons could relate to a lack of trust or understanding about why we were approaching them, especially students who dropped.

Answers to the interview questions were coded and put into NVIVO, a qualitative software package. After all of the interviews were coded, reports were generated by theme and then analyzed for this report.

Box 1: Data gathering instrument for current students

1. What drew you to this program?
2. We know that one of the issues with taking distance education classes is managing all elements of our lives to fit it into a schedule. What works well for you, in terms of making your schedule work and remaining in the degree program, i.e., how do you manage your time?
3. What are some of the strategies you employ to balance everything in your life: home, work, community, financial, and school, etc. What advice would you give to others?
4. What did you know about taking distance education courses before this experience? What would you have liked to know?
5. Are there others in your community taking courses? If so, do you study with them or share resources (books, Internet access, etc.)?
6. Family support can be an important element when completing an educational program. In what ways has your family been a positive part of completing the program?
7. Please talk a bit about the support you may have received at work or in the community? Could you share a specific story that shows how this support has been useful to you?
8. How have the instructors been helpful in meeting your needs? Can you talk about a time when one of your instructors showed flexibility with your schedule, or helped you manage the conflicting demands on your time?
9. What advice would you give someone who is beginning the degree program and may be concerned about demands on their time?
10. To what degree if any, has the need for financial support been an issue for you?
11. Have you pursued any educational loans or scholarships? If yes, how did you learn about these financial resources?
12. How has having a reliable computer with Internet access been a factor in completing your coursework? Do you have high speed Internet and a reliable computer in your home? If not, do you have access to one? Do you have a quiet place to do your homework without distractions?
13. If we were to design a for credit orientation seminar for this program, what do you think it should include?
14. If you could have three wishes for this degree program, what would they be?

Box 2: Data gathering instrument for former students

1. What interested you in the degree program? What were you hoping for when you signed up for the classes?
2. Which of the following played a role in your decision to drop the class?
    - Scheduling—finding time to work on the classes
    - Support—having people around you support your need to spend time on the classes, did you know others who were talking classes with whom you could study?
    - Technology—did you have the technology resources you needed?
    - Understanding the program—was there too much confusion at the beginning?
    - Financial—was the cost of the courses a factor in your decision?
3. If you could have three wishes for the program, what would they be? If these needs would have been met, would you still be taking courses in the program?
4. If we were to design a for credit orientation seminar for this program, what do you think it should include
5. Do you think you might take courses for this program in the future? How could we be helpful to you? What courses interest you most?

VI. OUR FINDINGS

Findings from the study fit well into the Sloan pillars, allowing us to connect the study results with current best practice in the field. They also offer a way to organize the themes that emerged from the study as well as the suggestions and strengths we will build on as we work to improve the program. Specific findings by pillar follow with sample statements from students.

A. Learning Effectiveness

According to the literature and our findings, students believe that online learning is an effective and efficient means to achieving an advanced degree. Students in the Community Development Program were extremely impressed with the material in the program, in terms of it being rigorous graduate level work. They also appreciated the direct application of the material to their work. Students appreciated the faculty and diverse viewpoints. No student discussed a breakdown in cohesion or connected curriculum. In fact, students mentioned all of the opportunities the courses provided to them.

> This is the first time that I am taking an online course, and I knew it was going to have quite a few readings and writings, but…they have used Power Point…and also some other recordings you can download using your iPod…this has been very helpful for me because listening is a little better than reading…

> A project I had due last week was to quantitatively analyze a subject matter, which was interpreted from my employer as analyzing all of our police dispatch records for the purpose of an annexation project that's been going on. So, I was able to gain access to those records…

The literature also indicates the importance of facilitating communication and collaboration in the classroom. When the program began, faculty in the Community Development program cited some

difficulty with students using the discussion board. Some students hung back and only commented once in awhile. Or, students disappeared and then dropped out of the course. Some non-traditional students discussed their feelings of inadequacy because they had been away from school for awhile or did not know the subject matter as well as others. Faculty addressed this issue at a faculty meeting and provided one another with effective ways to initiate and maintain meaningful communication and collaboration in an online course. Because faculty in this program collaborate so effectively, they often invite one another to guest lecture or join the discussion board in one another's courses. This allows students to see the interconnectedness of the program's courses and institutions.

B. Cost Effectiveness

One issue that is prevalent in all online graduate programs is the lack of financial assistance. Scholarships and assistantships often readily available for on-campus students are difficult for off-campus students to access. When one of the universities in the inter-institutional programs tried to set up assistantships for its students, it was told by the institution that the students would have to be on-campus or monitored in person by faculty. This requirement is not workable for online students who live hundreds, sometimes thousands, of miles away. Other universities in the program did not research the possibility of having student assistantships, but this issue is being pursued within the program. The literature demonstrates that students in various online programs faced the same issue. Some students in our program cited finances as a reason for dropping or a difficult aspect of the program. Even if students can get financial aid, they do not always have a way to pay it off after they graduate, and are unsure how the degree will pay off for them in the future. One student said that she dropped out because she could not put tuition on her credit card.

> I think there [were] at least 2 other people [here] who applied and we just couldn't find funding right way or come up the financial support.

> I haven't figured out how I could afford it. I mean the one class is expensive…It's a question of money.

On campus students, obviously, face financial issues as well, but there are more resources available to them, including scholarships and assistantships. What the literature and this study indicates is that there ultimately needs to be more scholarship and assistantship opportunities offered to distance students, particularly graduate students. Before students make the investment in an advanced degree, they want to make sure that it is cost effective for them to enter the program. Iowa State University is looking into ways to offer graduate assistantships to the students in the Online Community Development Program; however, this can be difficult because of the need for institutional oversight.

C. Access

Access is an issue for all students. Even with the best high speed Internet, things can go terribly wrong for online students, in terms of problems with technology or lack of access. All of the institutions required Web access, but did not demand high-speed because many students live in rural areas where they cannot get high speed Internet. For students in the Community Development program, simply having a computer at home is an issue. One student drove 60 miles one way to get to a computer with Internet access at the library. This took a toll on her as a single parent and full time employee. She ultimately dropped the program. Other students cited issues with dial-up Internet access.

> If I am home, I have really archaic Internet service. Like, I still have dial-up service that is really bad. I have dial-up service that if I tell it to dial, maybe it will connect in the next hour, maybe it won't. It will maybe stay connected, maybe it won't.
>
> The problem I had is that the attachments were so large that I couldn't get them, and when I did get them, it was very costly to print them out.

For many students in the program, it is not even an issue of cost for high speed Internet; it is an issue regarding phone lines making their way out to their home. This is particularly true for students living on reservations.

D. Faculty Satisfaction

Faculty teaching online who also teach on campus can struggle with the overload aspect of teaching distance courses. There may be no compensation for their work, and it means one more thing to do. However, most faculty members enjoy teaching online and the different experience that it offers compared to a traditional classroom. Chat rooms make for interesting places to discuss controversial topics, and students who are non-traditional bring an altogether unique perspective to the classroom. This is very much the case for the faculty in the Community Development program. At faculty meetings they share their excitement about teaching online and want to discuss with others the interesting things they are trying in their classrooms. One professor in the program, who had never taught online before, transferred his lecture into downloadable files for use on an iPod®. He learned a great deal about how to use technology as a teaching tool, and his students gained easy access to his lectures.

At the beginning of the program, faculty from all institutions met at two separate faculty meetings to design curriculum in teams. Faculty worked together through an Appreciative Inquiry process to design a program that included courses on numerous issues in community development. Throughout the faculty meetings, program coordinators also worked to ensure that the multi-institutional, online group began to feel like a real faculty. Faculty members had to interview one another on several topics, including "If you could create the best community development program, what would it look like?" and "What does being part of a great faculty look like to you?" These answers were shared and put on posters around the room to remind everyone of meeting goals, as well as to motivate those in the room. Although some faculty members resisted the process at first, it has served the program well because faculty in this program appreciate one another and work diligently each semester on the curriculum offerings.

This study only included interviews with students, but conversations and meetings indicate that faculty are very satisfied with the progress of the program and are extremely willing to collaborate with faculty from different institutions. In fact, they look forward to it.

E. Student Satisfaction

From looking at multiple studies regarding student retention in online programs, as well as what students want from their online courses, the same issues cropped up in the Community Development Online Master's Program. Students who are doing well in the program have a lot of support from work and home. They are financially stable and able to pay for their classes without feeling burdened. If they need financial aid, they applied for loans and received them; they also know they can pay off these loans. They have organized a system for time management, and they have reliable, good technology to work with at home.

Many of the students who dropped out of the Community Development degree program or courses within the program often said they did not have enough time to commit to the program. Non-traditional students in the program often found the reading to be overwhelming and did not foresee the rigor involved in a master's degree program.

> I guess I had been investigating opportunities since my employer encourages higher education. I only have a bachelor's and so it works great. It fits in my schedule…I work for a local government, and the hours can be demanding.

> It takes more discipline than a regular class. That is one thing that has to be stressed. You also have to have proper connections at home or a place that you can have proper connection. A computer with a good program on it, I have a dial-up computer connection and this instructor likes to send power-point presentations to you and that takes a lot of time to download. Just beware of the limitations. The feedback is not as quick as you want. You send an e-mail or something and you can get a reply back but there is that time lag between when you come up with a question and when you get it answered.

> No matter what…you need to prioritize.

> Stay up on the work as much as possible. Call instructors right away with problems…they are so supportive.

> I did not anticipate the extensive amount of time that I would have to spend on the classes.

Some students also noted that their expectations for the content of the course did not match the reality. Some felt overwhelmed by the material and did not feel prepared. This was echoed by the instructors who said some of their students were struggling and needed tutoring or some preliminary coursework to complete the course.

> As one student pointed out, finding time alone to work online can be a struggle.

> I didn't have any time…it got to the point to where I didn't have enough time to sleep, and if I can't sleep, I can't do my job. And, if I can't do my job, I can't live.

Other students found it difficult to balance time for coursework and family.

> I have an eighteen, ten and 1 year old. It is easy enough for my 18 year old and my 10 year old because they don't particularly want to spend a lot of time with me anyhow. But my wife and my 1 year old just kind of say, "I don't understand why you can't just give us 5 minutes."

Others found time to be an issue from the beginning, and they did not have their books or financial resources in place.

> I just didn't put enough time in so that when the classes came on I was[n't] ready to go.

Some students in the Community Development program had never taken an online course, which made technology a factor as well. However, no students in this study cited that switching from one online learning technology system to another was a problem or a reason for dropping out of the program. In fact, most students appreciated that they were able to work with various professors and practitioners in the field.

Ultimately, students who remained in the program remarked how the instructors' flexibility with assignments and time management allowed them to remain in the program. Instructors also showed understanding about problems with technology.

> I was in Vermont last semester when a final paper was due, and I had a lap top that corrupted my paper, but I was able to get it to her within a couple of days. I had to redo a lot of it…and it turned out that the bibliography needed some work, and she was okay with that.
>
> [The professor] was amazing. She was always there when you needed her. She really understood what the distance students were going through and adapted the course as necessary.
>
> [The professor] has been tremendously flexible.
>
> I would say I have had excellent help and communication [from the instructors].

Finally, there are many issues that are out of people's control that come up when working with several adult, non-traditional students in an online program. People get sick, have family issues to attend to, or simply have personal situations that make being a successful student a struggle.

> I have multiple-sclerosis, and I have had a few bad days the last weeks. I have been just swamped with work so it is hard to keep up.

VII. SUMMARY AND CONCLUSIONS

The information from our study says that inter-institutional programs do not create additional barriers for students; rather they have the same issues as students enrolled in programs offered through one institution. Using the pillars as a framework for analyzing our data, we can identify specific strategies for enhancing the quality of the Community Development program and other distance programs as well. For the Community Development program specifically, we need to communicate more with students about the program and their experience, offer more information about financial aid, loans, and scholarships for graduate distance students, understand the technology limitations students are facing, help students manage their time more effectively, offer an orientation session for new students, and finally help students formulate realistic expectations for the program so they can successfully finish their coursework. In response to these suggestions, we created an online newsletter for the program that has helped students feel like they are part of a program, generated additional enrollments, and addressed some of the unspoken issues identified in the interviews.

Our findings come from an admittedly small sample, yet we feel this study provides an important first step to creating a better understanding of how inter-institutional programs work and how students experience them. Overall, students in the evaluation process did not mention that switching between

university systems and teaching technology posed a problem. As long as they had someone they could contact for help at any given time, flexibility with their coursework, and understanding about their life situation, they had a positive experience in the program. Thus for our program, the student experiences in an inter-institutional online program looks virtually the same as those in a program offered by one university. With progressive faculty in their respective fields coming from five accredited state university, students in the Community Development Online Master's Program do have great opportunities to earn their master's degree and hone their skills as a practitioner, while staying in their home community.

VIII. ABOUT THE AUTHORS

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FACILITATING CRITICAL THINKING THROUGH ONLINE COURSES

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ABSTRACT
Development of critical thinking abilities is essential for students in clinical disciplines of the health sciences. Past research has shown that critical thinking is a learned skill that can be fostered through teaching strategies. Ten educational strategies that were developed and tested by the authors in online courses are presented to assist instructors to encourage students in the health sciences to improve critical thinking processes.

KEYWORDS
Critical Thinking, Health Science, Strategies

I. INTRODUCTION

Advanced abilities in critical thinking processes for clinical practice should be a goal of all nursing and health science programs. With the complexity of healthcare today, critical thinking ability is crucial for problem solving and the processing of relevant information. Graduates of health science programs must use critical thinking to decide how to help individuals, families, and communities to promote, protect and restore health. Because the phenomenon of human health is so complex, critical thinking abilities are needed to understand and apply health knowledge. The purpose of this paper is to provide ten strategies to facilitate students' critical thinking for faculty in nursing**,** nutrition**,** and the other health sciences who wish to develop their own online courses. These strategies, based on existing literature sources, have been used and tested by the authors. Examples are provided with each strategy of student results.

II. CRITICAL THINKING

Critical thinking is a subset of the three thinking processes of reasoning, making judgments and decisions, and problem solving [1, p.8]. In using these three types of thinking throughout life and clinical practice, the process of thinking critically occurs some of the time, e.g., when a person weighs the evidence to make a decision. The three key features of critical thinking are that it involves "effectiveness, novelty,

and self direction" [1, p.11]. Critical thinking is not a skill that transfers to other unrelated thinking processes, but is a process that occurs in relation to specific domain content. Content knowledge is needed in order to achieve appropriate critical thinking in knowledge domains. An important advantage of using critical thinking processes is that it helps learners to overcome their negative egocentrism and sociocentrism [2, 3].

Through collaborative use of critical thinking processes with other students during reasoning, making decisions, and problem solving, learners gain a foundation for independent and interdependent critical thinking. Ability to use critical thinking varies, depending on comprehension, self-assuredness, level of maturity, experience with critical thinking processes, and other variables [2].

Through critical thinking, students focus on the processes of learning rather than just attaining facts about phenomena [4]. Critical thinking helps learners to create and apply new knowledge to real-world situations. When learners think critically, they become actively responsible for their own education, which can lead to wisdom--not just the learning of new information [5, p. 15).

Critical thinking contributes to the rational and reflective processes of making judgments in clinical practice [2]. Clarity in judgment involves a breadth of knowledge and a depth of understanding which, when nurtured by educators, lay the foundation for practical application and the gaining of wisdom. Critical thinking includes the ability to tolerate and manage ambiguity as part of the complexity of human experiences and professional roles. To tolerate and manage ambiguity means that health professionals embrace, or at least accept, the ambiguity of clinical judgments in health care instead of having emotional or avoidance reactions to the ambiguity.

More than two centuries ago, Socrates devised a method of questioning and analysis that required clarity of thinking and logical consistency [3]. The Socratic method of questioning set the stage for the study of critical thinking. More recently, critical thinking has been extensively studied, showing that people with the same degree of education and professional preparation can and do vary widely in basic thinking abilities [1, p. 8; 6, p. 60; 7, p. 8]. The research also shows that thinking abilities can be improved through focused educational activities and individual efforts [2, 7, 8, 9, 10]. Based on previous research on basic thinking abilities, faculty members who teach nursing and health science courses should assume that the students in their classes vary in thinking abilities and that their thinking abilities can be improved and transferred to clinical practice. The facilitation of critical thinking is best achieved in conjunction with domain content, so incorporating these processes within online courses on any health science topic will help students to further develop the use of critical thinking for clinical practice [1, p. 8; 2].

There are many different theoretical perspectives on critical thinking that mainly derive from the disciplines of psychology, educational psychology, and cognitive psychology, e.g., the views of cognitive scientists as summarized by Willingham [1, p. 8]. Using one of these views is important because students need to know specific critical thinking metacognitive concepts to focus on using them. An example is when students are prompted to analyze a clinical situation by considering both sides of the issue before making a decision. To identify the critical thinking concepts that are relevant to nursing, Scheffer and Rubenfeld [11, p. 352] conducted a Delphi study of 56 nurse experts in critical thinking. The results were a definition and description of critical thinking in nursing as an essential component of professional accountability and quality nursing care. "Critical thinkers in nursing exhibit these habits of mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and

transforming knowledge" [11, p. 357; 4] (see Table 1). The research-based strategies for online courses proposed here are designed to facilitate these seven cognitive skills and 10 habits of mind in online courses in nursing, nutrition, and other health sciences.

Characteristics	**Definitions**
Cognitive Skills	
Analyzing	Separating or breaking a whole into parts to discover the nature, function and relationships
Applying Standards	Judging according to established personal, professional, or social rules or criteria
Discriminating	Recognizing differences and similarities among things or situations and distinguishing carefully as to category or rank
Information Seeking	Searching for evidence, facts or knowledge by identifying relevant sources and gathering objective, subjective, historical and current data from those sources.
Logical Reasoning	Drawing inferences or conclusions that are supported in or justified by evidence
Predicting	Envisioning a plan and its consequences
Transforming Knowledge	Changing or converting the condition nature, form or function of concepts among contexts
Habits of the Mind	
Confidence	Assurance of one's reasoning abilities
Contextual perspective	Consideration of the whole situation, including relationships, background, and environment, relevant to some happening
Creativity	Intellectual inventiveness used to generate, discover, or restructure ideas; imagining alternatives
Flexibility	Capacity to adapt, accommodate, modify or change thoughts, ideas and behaviors
Inquisitiveness	An eagerness to know by seeking knowledge and understanding through observation and thoughtful questioning in order to explore possibilities and alternatives
Intellectual integrity	Seeking the truth through sincere. honest processes, even if the results are contrary to one's assumptions and beliefs
Intuition	Insightful sense of knowing without conscious use of reason
Open-mindedness	A viewpoint characterized by being receptive to divergent views and sensitive to one's biases
Perseverance	Pursuit of a course with determination to overcome obstacles
Reflection	Contemplation upon a subject, especially one's assumptions and thinking for purposes of deeper understanding and self-evaluation

Table 1. Critical Thinking Categories and Definitions [11]

III. STRATEGIES TO FACILITATE CRITICAL THINKING THROUGH ONLINE COURSES

Thinking processes can be improved through teaching, coaching and practice, so specific educational strategies can be used in online courses to facilitate students' critical thinking processes. The following

ten strategies are proposed: (1) ask–questions that can be answered through information seeking, (2) expect students to describe the meanings of their required readings in their own words, (3) motivate students to use effort through grading criteria, (4) stimulate students to give examples of concepts or theories being studied, (5) provide case studies or other examples for application of class content, (6) prompt students to ask questions of each other and the instructor; (7) phrase questions so that additional independent research or reading is required, (8) promote student debates on controversial subjects within the discipline, (9) require students to use journaling, and (10) reinforce students' use of critical thinking (see Table 2).

1.	Ask questions of students
2.	Expect students to formulate answers to questions in their own words
3.	Motivate students to use effort through grading criteria for participation in discussions
4.	Stimulate students to give examples of concepts being studied
5.	Provide case studies or other examples for student application of concepts and theories
6.	Prompt students to ask questions of themselves, each other and the instructor
7.	Phrase questions to students that require additional independent research or reading
8.	Promote student debates on controversial subjects within the discipline
9.	Require a course-related journal
10.	Reinforce students' use of critical thinking through positive reinforcement

Table 2. Summary: Teaching Strategies to Facilitate Critical Thinking in Online Courses

A. Asking Questions

A basic strategy that has strong research support is to ask students questions and expect them to find and provide the answers [1, 8, 10]. Questions can be factual, descriptive, clarifying, or value-seeking. Students are motivated to explore the unknown and make cognitive connections to the known by seeking clarification. Questions can help students move through a process of deductive and inductive reasoning. Questions hold students accountable and help them to internalize habits of critical thinking while conditioning them to use patterns of critical thinking behaviors through guided practice.

The answers to questions do not have to be difficult or hard to find; the answers can be found, for example, in the assigned readings for a course. But, the effort of looking for the answers generates the cognitive skill of *information seeking*. Questions at a higher level of ability are those that require the cognitive skills of *analysis* and *logical reasoning* and questions that generate further questions and inquiry. These types of questions generate the cognitive skill of *transformation of knowledge* and development of the habits of mind of *flexibility and creativity.*

Example of Student Outcomes. In a course on community health nursing, the question was: What are Advance Directives? One student provided an answer and other students provided further clarification, such as below:

To add to Emily's comments, the Patient Self-Determination Act requires healthcare providers to discuss advance directives with patients and include in the health care record whether the patient has signed advance directives. I believe that it is crucial for all people to have advance directives. I often encounter situations where patients do not have advance directives. If their status rapidly changes and they are no longer able to make decisions, families often disagree about what treatment should be given and what treatment should be withheld. To avoid any confusion, families should discuss their wishes with each

other and complete advance directives. This ensures that their wishes are respected and carried out.

B. Writing in Own Words

A second strategy is to expect students to formulate the answers to questions in their own words. This encourages development of the habit of mind, *flexibility*, and may also require the cognitive skills of *analyzing* and *logical reasoning*, albeit sometimes at a basic level. Students who cannot formulate the answers in their own words can use the words of the authors they are reading, but they should put them in quotation marks and cite the page numbers. In our experience, students generally do not quote from the book, even though they have the opportunity to do so. It may be that they want to appear smart enough to peers to be able to write it in their own words. Writing in one's own words is also encouraged by developing assignments that require students to provide their opinions based on course content.

1. Example of Student Outcomes

In a food politics course, the teacher asked students their opinions of the Breastfeeding Promotion Act (United States House of Representatives, 2007), which amends the Civil Rights Act of 1964 to include lactation (breastfeeding, including expression of milk) as protected conduct. One student posted the following opinion:

> As we review the legislation and policy efforts to encourage and protect breastfeeding as a public health issue, I started to consider what is behind the letter of the law. I thought Margaret brought up a good distinction in the Pennsylvania law where Republicans debated over the wording *right to breastfeed*...replaced by *freedom to breastfeed.* States' laws in the US literally provide the "freedom" to breastfeed and not the right of a child to receive breastmilk. Consider the Texas and California statutes, which prohibit the sale of breastmilk. As breastmilk is the ideal food for (almost all) newborns and infants through at least 6 months of age, then child should have a "right" to breastmilk. But, that's not the case, *to wit*: suppose an adopted infant must be cared for at a time when he should be receiving breastmilk. How is this infant protected under current states' policies for breastfeeding? The answer—the baby is not protected at all. The focus of state legislation and workplace policy is to ensure the freedom of the lactating mother to feed her baby from the breast. This strikes me as misdirected policy. The primary health benefits of breastfeeding are acquired by the infant, not the mother. Policy changes that protect and encourage breastfeeding should start by protecting the *infant's right to breastmilk*.

2. Plagiarism

A related issue is that students may post a response as if it is their own writing but it was plagiarized [12]. Plagiarism of Internet sources is particularly prevalent in online courses. Cyber-plagiarism can be prevented, or at least thwarted, by using a combination of strategies (see Table 3). The first step is to be aware of plagiarism. All teachers need to educate themselves and their students about plagiarism.

1.	Develop assignments that are clear to the students.
2.	Provide a list of appropriate subjects. Assign narrowly focused topics rather than broad general ones, or ask students to write about current events as they relate to class materials.
3.	Require specific components in assignments, such as headings, number of pages, referencing style.
4.	Require process steps for the assignment, i.e., stagger due dates for different parts of a

	paper. For example, the bibliography can be due a week before the final paper, or specify what materials students can use, or assign two or three smaller papers throughout the term rather than a single large one.
5.	Have students include an annotated bibliography as part of the assignment, or ask them to include a photocopy of the first page of each article they cite.
6.	Require most references to be up-to-date: no more than 3 to 5 years old.
7.	Require an essay about the learning process, e.g., on the day the paper is due, ask students to write an essay summarizing the salient points. In a traditional face-to- face course, this would be accomplished by an oral summary of the work.
8.	Require students to submit notes or outlines with their paper because you are looking for evidence of original thought.
9.	Change the paper topics each time the course is offered.
10.	Require that students provide complete URLs for online articles.

Table 3. Strategies that Encourage Individual Work and Also Prevent Plagiarism

Course materials should be developed that discuss the benefits of citing sources, and make the penalties clear for intentionally trying to pass off someone else's work as one's own. Teachers also need to adopt strategies that make their assignments sufficiently unique so that students in the course will do their own work to fulfill the task requirements. Assignments can be designed so that only newly written papers will meet the grading criteria.

C. Grading

Because studies have shown that individual effort improves thinking abilities [1, p.8; 7, 10], a third strategy is to motivate students to apply effort. Grading is a traditional and time-honored approach to motivate students' to try harder.

Each of the authors of this paper use a different grading rubric for students' postings in course Discussion Boards. Lunney uses a weekly grading system in which 95 is awarded for excellent effort, with at least 12 postings that include 6 responses to other students' postings. Grades at 5 point increments are awarded down to 70, which is given for minimal effort that week. Each grade is associated with specific criteria and students must first use the criteria for self evaluation before they receive the instructor's grade. Frederickson pro-rates the credits so that students may receive between 5 and 10 points each unit depending on the complexity of the material and the quality of the student's answers. The teacher posts examples of a 5 point answer and a 10 point answer to motivate students to try for a higher number of points. Sparks uses a 5-point grading system, from 0 to 4, with 4 being awarded for excellent responses and 0 being awarded for unacceptable responses. To achieve a grade of 4, the posting needs to be accurate, original, relevant, teaches something new, and is well written. McDuffie uses a grading system that gives students points when online assignments are completed in totality within the specified time period. Students may earn a maximum of 5 points depending upon the accuracy with which assignments are completed.

1. Examples of Students Outcomes

In online courses using Lunney's grading system, a majority of students post 10 to 12 times and respond to other students' answers on that week's topic in 6 of the 12 postings. The goal of most students is to receive a 95 for each week's discussion, which helps to ensure a good course grade. In a course taught by Frederickson on evidence based practice, a student presented each of the categories of evidence with one example; a minimal response for which 5 points were awarded. Another student identified each of the

categories of evidence and discussed how a descriptive study could be modified to achieve a higher ranking; this student was awarded 10 points. The points for each unit are averaged for the course participation grade. With Sparks method, each student's contribution to the discussion is evaluated 10 times during the semester (1 absence is permitted without penalty). The range of possible points per session is 0 to 4, thus 40 is the maximum possible score for the discussion segment of the course. McDuffie uses points that are translated into a percentage of the total grade. Students are expected to post weekly achieving a maximum of 5 points per week, which, at the end of the semester, equals 20% of the total grade. Failure to post impacts the total grade. One student wrote as part of her evaluation of the course:

> I like online classes better than on-campus classes because it gives me the time I need to research and formulate my thoughts before posting them, and I'm not intimidated by the fast thinkers and the more verbal students. While I thoroughly enjoyed reading the postings because I learned so much, I felt I had something to contribute both from my experience and the required readings. The first meeting helped to put me on track, but I dreaded the last session until one of the other students said to me, `I always looked forward to reading your postings. They were so insightful.' I love on-line courses.

D. Examples of Concepts

A fourth strategy is to ask students for examples of concepts. The strategy of asking for examples stimulates the cognitive skills of *analyzing* and *discriminating* and the habits of mind of *flexibility* and *reflection*. The need to provide examples gives students opportunities to connect what they are learning to their past knowledge and their personal experiences.

1. Examples of Students' Outcomes

The following posting took place in a discussion of ethics:

> Last month I was asked to co-sign a consent for surgery, but I thought that the patient was not clear about what he was signing. The patient was not literate enough to read the consent form and the physician did not verbally explain everything that was on the consent form. In this case, the principle of autonomy was being violated. To resolve the issue, I asked the physician, with the patient listening, to explain the content of the consent form and then validated that the patient understood the explanation and agreed to the surgery. After this was completed, I co-signed the form. Afterwards, the physician and I briefly discussed the related ethical issues.

The following postings are students' responses to an assignment in which students were asked to propose new nutrition objectives to be included in *Healthy People 2020:*

- Increase the number of urban farms and other urban food production alternatives.
- Increase food security among US households in a manner that provides optimal and equitable nutrition and health as well as to reduce hunger.
- Increase the availability of reasonably priced low-fat, low-sodium, nutrient-dense foods in commercial food outlets.
- Eliminate the availability in schools of foods that would compete with healthy foods.

E. Application

Strategy five is to motivate students to apply the content to a case study, a published article, or a specific task that requires decision making or problem solving. This can be done by including application of content in the grading criteria, and giving students higher grades for successful application. This is

important because evidence shows that students do not necessarily transfer critical thinking abilities to clinical practice [2]. Students also need opportunities to practice the specific types of critical thinking processes that are needed for specific kinds of content [1, p.8]. In a course about the research process, for example, a research article can be supplied each week for students to apply the content learned in required chapters.

1. Examples of Students Outcomes

The following is from an undergraduate student's posting in a research course, with the weekly topic being quantitative research designs:

> This study is nonexperimental quantitative research—no manipulation is introduced for obvious ethical reasons. There is also no control group. It is a descriptive, correlational study. I think it is a within-subjects design as far as type of group comparison because we are looking at different levels of distress in relation to different responses from a parent within the same parent/child dyad. Since it collects data multiple times in a short period, I think, it is a cross-sectional study. With respect to observance of variables, it is a prospective study and it occurs in real-world setting, a urology clinic. The inclusion was based on 4 criteria which was a way to control intrinsic subject characteristics. Since the sample size was very small, I think the statistical conclusion validity, as well as internal and external validity were undermined, although no threats to internal validity or problems with external validity were identified. It is hard, at least for me, to determine to what extent is this study externally valid, which is a main question for evidence-based practice purposes. As mentioned before, sample size is the major limitation in this study. The author acknowledges this fact and maintains caution in interpretation of the research findings.

F. Prompt Students to Ask Questions

Asking questions about any topic, strategy six, facilitates the effectiveness, novelty, and self direction of critical thinking by generating additional information for improved reasoning, judgments and decision making, and problem solving [1, p.8]. Helping students to ask the "right questions" to guide critical thinking can be accomplished by prompting them to ask questions of themselves, each other, and the instructor related to the content. This strategy works especially well when used along with application of the content to a decision making or problem solving task (see above strategy). Twelve major questions to best guide critical thinking are summarized and explained by Browne and Keeley [8], ranging from what words or phrases are ambiguous (chapter 2) to what reasonable conclusions are possible (chapter 13). Paul and Elder [10] provide many possible questions that students can ask themselves or others.

1. Examples of Students' Outcomes

In an online course on family theory in nursing, the topic was family structure. Students were asked to identify the composition of modern families. The class included a number of students from different countries. A student from Africa identified families divided by war and migration. The faculty asked the students to discuss how this division affected family roles and to think of other family structure changes that would result in changes in family roles. The outcome was that students explored different situations within and outside the family that might change family roles and asked each other questions such as: If a relative moves in, how would that affect roles? How close a relationship would it have to be to invite or not invite a relative to live with your family?

In a discussion about Public Law 108-265, which mandates local wellness policies in schools, an example

of a student's use of questions was as follows:

> My first question is: Why use words like 'meet minimum requirements'? Why not set the bar higher? As Michele Simon discusses in Appetite for Profit, schools have the rare opportunity to teach kids what it means to be healthy--to eat a well-balanced diet and to by physically active on a daily basis. Why water down a potentially influential mandate by making the requirements vague, using words like (bare) 'minimum' and 'least possible'? My next question is: are they really requirements? Where does it discuss what the ramifications are if a school doesn't follow through? Is the ONE person (as minimally required by the mandate) that is responsible for ensuring that the school meets the requirements going to be penalized? Why not require a team of people, expert in their field to be responsible, as the model school policy suggests?

G. Questions Requiring Additional Research

Strategy seven is for instructors to phrase questions so that additional independent research or reading is required. A case study can be presented that illustrates a complex situation followed by questions that probe for the rationale and require additional reading. Frederickson uses concept mapping, requiring students to place nursing actions in sequence followed by a question about the effect that an additional nursing diagnosis might have on nursing interventions. Students then must discover from their written and practical resources, how this additional diagnosis will affect their decisions and provide rationales based on additional readings. This strategy has the potential to promote development of the seven cognitive skills and many of the 10 habits of mind.

1. Example of Students' Outcomes

In a nutrition course, in response to the prompter—predict how a New York City regulation that trans-fats must be labeled in restaurants will affect public health—a representative student response was:

> The National Restaurant Association called the ban burdensome and unnecessary. They do not believe that a municipal health agency has any business banning a product the Federal Drug Administration has already approved. Fast-food restaurants and other major chains were particularly interested in the board's decision, because for these companies, a trans-fat ban would not just involve substituting one ingredient for another. In addition to overhauling recipes, the restaurants have to disrupt nationwide supply operations and try to convince customers that the new french fries and doughnuts will taste just as good as the originals. New York City's move to ban trans-fats has mostly been applauded by health and medical groups, although the American Heart Association warns that if restaurants are not given ample time to make the switch, they could end up reverting to ingredients high in saturated fat, like palm oil.

H. Debates

The eighth strategy is to promote student debates on controversial subjects. This provides students with opportunities to use all of the cognitive skills, with emphasis on *analyzing, logical reasoning*, and *discriminating* but also including *predicting* and *transforming knowledge*. A debate promotes confidence, a critical thinking habit of mind, and develops students' skills to articulate before an audience, albeit an audience that is not in view. The teacher provides a pool of acceptable topics within the discipline. Students then choose an issue from the entire pool, take a position on the topic they have chosen, and present their arguments defending that point of view. Students have opportunities to counter the arguments of two or three of their classmates. The author of the original position should also have

opportunities to respond to critics, which forces the author to re-examine the completeness of approach to the topic in light of counter arguments or other points of view. An example of a debate in a nutrition class is when students take the positive and negative sides take sides in relation to the use of high fructose corn syrup in the food supply.

1. Example of Students' Outcomes

A lively debate in a nursing class occurred on the topic of promoting vasectomy in men versus the sterility methods typically used in women. Following library searches, both sides of the discussion were argued and followed by each side responding to questions posed by the other. The debate panel made up of classmates voted on categories such as ability to effectively articulate (write) thoughts, persuasiveness of arguments, citing of experts, timing, clarity of facts delivered, logic of argument, and knowledge learned by audience. This particular debate question has been used by the author with four different classes over five years. With each class, both sides of the debate have been able to present very persuasive arguments, twice ending in a tie vote, and the pro and con side winning once in other discussions of the issue. Students have admitted they approached the subject having a preconceived opinion but left not being swayed one way or the other; a few indicated a change of mind while others felt they needed to search additional resources on their own.

I. Journals

The ninth strategy, requiring course-related journal-writing, specifically promotes the habit of mind of *reflection*, but can also promote all of the cognitive skills and habits of mind. Journaling enables development of acceptable writing skills and helps students to clarify their thinking and explore their personal epistemology [2, 13]. The focus of a journal can actually be the students' awareness of the thinking processes being used for discipline-related tasks, i.e., metacognition or thinking about thinking. A critical thinking theoretical framework such as in Table 1 is provided to students. Students use this framework to identify in a written journal the thinking processes that they used in course assignments, e.g., deciding what is the nursing diagnosis [14]. A journaling experience might benefit a nutrition assignment that requires students to become aware of their own values, prejudices, and beliefs, e.g., about obesity, overweight dietitians, new mothers who bottle feed, and parents who take their children to fast food restaurants.

Reflective journaling is also useful to develop the cognitive skill of *transforming knowledge* such as with a goal of fostering cultural competence and social responsibility. According to Rubin [15, p. 460], the virtues of compassion, righteousness, propriety, and wisdom can be measured by selecting key words and phrases found in individual student journals. The presence of these virtues may indicate enhanced cultural understanding.

1. Example of Students' Outcomes

In an online course on gender and stress, in which private journaling is a requirement, the outcomes of journaling are discussed in the last two online class sessions. Students' postings have supported the outcomes of improved attitudes, beliefs and behaviors related to culture and gender. In a course unit on stress and women with multiple roles, one student wrote:

> I have a new respect for myself. My family has always been very traditional. My mother stayed home with us kids and waited on my father when he came home. I have felt inadequate as a wife and mother, feeling that I'm not as good as my mother. After our discussions on Bb and writing

> down my feelings in my journal, I see that I don't fit the mold of my mother. I have a job, take care of the kids and my husband and go to school. Sometimes I become crabby with my family and friends. I guess I'm just tired. I now see that I need to be kinder to myself, more forgiving. I do a lot and I'm NOT MY MOTHER.

There were more than 40 exchanges responding to this posting in a class of 16, who were mostly female.

J. Reinforce Students' Use of Critical Thinking

Learning through critical thinking cannot take place without the use of reinforcement, the tenth strategy, which implies that there exists a connection between a stimulus (e.g. the question) and a response (student's exploration to find the answer). As observed by educational psychologist Thorndike, who is credited with developing the theories of stimulus-response and Law of Effect almost a century ago, "Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction will, other things being equal, be more firmly connected with the situation so that when it recurs, they will be more likely to recur…The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond" [16]. Thorndike has authored hundreds of publications and has contributed to advancing the theories on learning and the learning process. Even today Thorndike's stimulus-response theory is highly valued and quoted among educators [17, p.170].

Teachers encourage and reinforce critical thinking when they establish a learning environment that is conducive to exploring the unknown, truth-seeking, open-mindedness, logical reasoning, flexibility, and so forth. This can be done through praise and positive reinforcement. When students participate in class discussions and the teacher responds with "good," or "that's an interesting point," or "keep up the good work," and so forth, students provide further input because they appreciate the positive reinforcement. Other ways that teachers reinforce students' critical thinking efforts are to respond to students' papers, tests and journals within a specific time period, e.g., a week or two. Students are encouraged when they know their postings are being read.

1. Example of Students' Outcomes

In an online course on gender and stress, the topic for discussion included areas such as: pregnancy and child rearing, multiple roles for women, adolescence, and body image. During the discussion of pregnancy, one of the men posted an inappropriate joke about women's roles and their genitals. The teacher deleted the post and began a lengthy discussion with him through email about the appropriateness of behavior and professional discussions about women and their roles. After a few exchanges, he was open to the idea that cultural background and socialization experiences influence one's beliefs and behaviors. After numerous interactions, he began posting on Bb with his classmates, shared a synopsis of the experience, and invited others to share their experiences about changing behaviors to fit a newly adopted culture, beliefs and behaviors. In the end of semester evaluations, students commented that this Bb discussion experience was one of the most important in changing their thinking and approaching nursing situations with more flexibility and openness.

IV. SUMMARY/CONCLUSIONS

Critical thinking is an intellectual process that is necessary for making clinical judgments [1, 2]. Traditionally, in health professions education, critical thinking was taught in clinical settings. Online teaching and learning, however, provide new opportunities for stimulating critical thinking for clinical

problem solving. Online learning permits students the opportunity to review and re-review lectures and discussions thus enabling additional thinking time. This enhances the ability to learn, reflect, and problem solve through the use of critical thinking strategies. Faculty members foster critical thinking through the skilled use of coaching, re-directing, focusing and skilled questioning techniques that assist to keep all participants fully engaged in the process. Online teaching methods enable a kind of "stick to it" format that is not possible in in-class teaching based on a number of factors such as insufficient time, verbose versus quiet students, intimidation, and environmental issues.

The authors described ten different strategies that can be employed to stimulate critical thinking in on-line teaching. These ten strategies, when used interchangeably, encourage depth and breadth of thinking and generate examination of clinical issues from more than one perspective. To maintain and stimulate student interest and involvement, each of the different approaches needs to be varied and challenging. Through online teaching, instructors can foster opportunities for students to actively engage in critical thinking processes.

IV. ACKNOWLEDGEMENTS

Development of this paper was partially funded by a grant from the Alfred P. Sloan Foundation awarded to The City University of New York (CUNY) and the individual authors as CUNY faculty members who teach online courses. We also acknowledge the students in our online courses whose discussion board posts are quoted in this paper. Any names within the quotes were changed to maintain anonymity.

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A SYNTHESIS OF SLOAN-C EFFECTIVE PRACTICES

December 2008

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ABSTRACT

To support continuous improvement in the quality, scale and breadth of online education, the Sloan Consortium invites practitioners to share effective practices. This report synthesizes effective practices submitted by more than 150 Sloan-C organizations that are listed as of December 2008 in the Sloan-C Effective Practices online collection at http://www.sloanconsortium.org/effective. The synthesis includes links to the provider institutions and to detailed postings about practices.

KEYWORDS

Learning Effectiveness, Scale, Institutional Commitment, Access, Faculty Satisfaction, Student Satisfaction, Quality Framework

CONTENTS

I. INTRODUCTION

The Sloan-C Effective Practices collection enables educators to share practices that help achieve the Sloan-C purpose of making quality online education more affordable, accessible and effective. To measure progress towards this goal, Sloan-C's quality framework calls for metrics. The framework identifies five pillars as key principles for achieving quality, and Effective Practice postings demonstrate evidence of effectiveness in each of the pillars.

Learning Effectiveness: Online learning outcomes meet or exceed institutional, industry, and/or community standards

Scale: Institutions continuously improve services while reducing cost to achieve capacity enrollment.

Access: All learners who wish to learn online have the opportunity and can achieve success.

Faculty Satisfaction: Faculty achieve success with teaching online, citing appreciation and happiness.

Student Satisfaction: Students are successful in learning online and are pleased with their experience.

As technology introduces new possibilities, the effective practices collection is a work in progress. To build and share emerging knowledge and to recognize excellence, practices nominated for Sloan-C awards meet these criteria:

- **Innovation**: The practice is inventive or original.
- **Replicability**: The practice can be implemented in a variety of learning environments.

- **Potential impact**: The practice would advance the field if many adopted it.
- **Supporting documentation**: The practice is supported with evidence of effectiveness.
- **Scope**: The practice explains its relationship with other quality elements.

Practices in one area affect quality in others, thus the pillars are related and interdependent. When practices are submitted to Sloan-C, editors evaluate them and show how they link to other practices.

This synthesis groups effective practices according to solutions that contributors have provided to some frequently encountered questions. Hyperlinks are provided so that readers can examine details about practices and the organizations that have shared them with Sloan-C.

II. STUDENT SATISFACTION

Sloan-C's goal for student satisfaction is that students are successful in learning online and are typically pleased with their experiences. Measurement of student attitudes finds that:

- Discussion and interaction with instructors and peers is satisfactory;
- Actual learning experiences match expectations;
- Satisfaction with services (advising, registration, access to materials) is at least as good as on the traditional campus;
- Orientation for how to learn online is satisfactory; and
- Outcomes are useful for career, professional and academic development [1].

Student satisfaction with the entire learning experience begins with preparing learners for the online environment, continues throughout the curriculum, and continues past graduation with career services and lifelong learning. As emphasized by the Western Cooperative for Educational Telecommunications 2002 report "Beyond the Administrative Core: Creating Web-Based Student Services for Online Learners," "students expect more than static web pages—they are looking for personalized and integrated information and services that will support their higher education experience [2]."

1. How can schools help learners get started with online learning?

A full range of online services comparable to services provided on campus helps ensure that the quality of learning is at least equivalent to learning in face-to-face settings. The Illinois Virtual College Online Student Resource Center (IVC) helps students succeed in online learning with online resources for: Getting Started, Student Resources (Assessment & Testing; Diverse Populations; Financial Assistance; Health & Wellness; New Students; Purchasing Books Online; Returning Adult Students; Transfer Information), Academic Success Skills (Study Skills/Online Tutoring Sites; Library Skills/Online Research Sites; Writing/Communication Skills; Survival Skills; GPA Calculator), Career & Life Planning (including tutorials that walk students through planning process), and Technology Tools (including tutorials). Students interested in taking an online course can walk through the resources at their own pace, or they can go directly to a category of information. Students at all 66 Illinois campuses can also visit in person any of 40 IVC Student Support Centers, one located in every community college district in the state. Stark State College requires students to complete an agreement that tells them what to expect and how to succeed. Fernuniversitat Hagen provides online tools for enhancing learning effectiveness for easy access to personal data and calendars, assignment results, courses, and contact information for tutors and classmates. At the University of North Texas ecampus, a student guide meets all five pillars of quality by providing access to course information for online students, student satisfaction in knowing that they are prepared for the academic and technical requirements of the online course, learning effectiveness in

permitting students to get a head start on course requirements, faculty satisfaction in knowing that their students know about course expectations, and cost effectiveness and institutional commitment in making course and program information available to prospective and current students before they decide to enter. University of North Texas also requires beginning students to enroll in Web Institutes so that student cohorts support one another. At Saint Leo University, a required online orientation introduces learners to resources and expectations, with an overview of support services and resources, through an online, instructor-led orientation course that assures connection and connectivity to entry level students. At GoArmyEd (formerly eArmyU), ViCTORY (Operation Virtual Counselor Transforms Online Resources for You) is a model for Soldier academic support and success; this fully integrated proactive student-support reaches out to soldiers in more than 50 countries. eArmyU counselors regularly contact soldiers at critical points in their progress, helping to ensure a high rate of completion. Similarly, mentors at Western Governors University know that learners' approaches in its competency-based program may range through a continuum of transforming, performing, conforming or resisting, and so mentors establish regular contact with learners to reduce feelings of frustration and isolation. Long Beach City College (LBCC) provides its orientation on learning skills, Internet skills, and communication skills to all LBCC faculty and students and to others who wish to use the resources at S.I.D.E. Road: Success in Distance Education. Washington State University helps students learn to communicate online with the help of virtual facilitators.

2. How can schools help learners make good choices?

To help students project and manage their time and also to help decide which courses they can succeed in, Troy State Montgomery provides a syllabus display and time on task as part of the registration process. At Athabasca University, the detailed syllabus helps students preview expectations before taking the course and reduce anxiety, pace themselves and even work ahead of schedule to accommodate business and personal commitments. At the University of Phoenix (UOP), personalized, student-centered life-long learning for adult learners includes consideration for the schedules of working adults; thus, courses are taken one at a time during a six-week-long intensive semester. UOP's small class size, academically qualified practitioner faculty, and outcomes oriented curricula focus on providing students with workplace competence, teamwork practice, and improved communication skills. At Washington State University, flexible enrollment options offer students control of learning, so that they can choose to enroll in a regular semester or extend for a couple of semesters. To help establish social presence and preview subject matter for prospective students, Washington State University provides brief RealPlayer videos in which the professor welcomes students with an introduction to the course. Empire State College requires a course that becomes an educational planning environment in which students and their mentors assess their preparation for college; consider personal, professional and educational goals; identify prior learning; analyze what students need to learn; select courses; choose a concentration, make a curricular plan, and develop and articulate a degree program. At Northern Virginia Community College, a tutorial instructional model builds learner-instructor interaction into course, assignment, submission and feedback processes.

3. How can schools build community among learners?

Because student satisfaction is rooted in a learning community, The Pennsylvania State University World Campus's community website connects online students to the university and builds a learning community; and its student/faculty helpdesk, an online customer service, makes online experiences more satisfying for faculty and online students. At the State University of New York Learning Network (SLN), courses emphasize the importance of required interactions between student and faculty, and SLN continuously assesses student satisfaction and reported learning, interaction, learning community formation, and more.

To encourage its graduates to stay identified with its community, University of California Berkeley offers tuition discounts for alums for online courses.

To prepare its students for their online course experience, Berkeley College has a comprehensive plan for preparing online students including an orientation site for its online degree students, a required online preparatory course that prepares online students to understand the particulars of online learning and navigate the course management system, an online library orientation, a special one-stop shopping center online degree site with messages from advisors and students services, an online tutoring site that is always available to help students with course material and writing assistance, and ongoing faculty and technical support. At Rochester Institute of Technology each online course has a customized course page with course information, school policies, access and equipment information, and resources. Frederick Community College (FCC) provides a comprehensive array of online library materials and services. Library resources available by remote access include the library catalog, reference data bases, online journals and full-text resources, government documents, news services, and other sources. The library also creates custom web pages with resources that are relevant to individual courses. Services provided online include reference and research assistance, document delivery, interlibrary loan, partnering programs with local libraries, and library user training, including research techniques.

To welcome students to the course community, a professor at Charter Oak State College telephones students on the first day of class to establish communication. At Mercy College, students feel more comfortable about asking for assistance when they can ask their peers, students who are tutors, facilitators, and role models. At the University of Massachusetts Lowell, a course community and resource website builds community building through sharing of student pictures, current and past student work and extensive resources. The University of Arizona College of Nursing Online PhD Program rotates student photos on its portal as an easy way for learners to match names with faces. “Well begun is half done” at Old Dominion University where the online student orientation website an interactive gateway that helps prospective students to become acquainted with distance learning. Students can assess their computer proficiency, learn about course registration and choose from a variety of helpful tutorials. Faculty may refer students and advisees to the site and it can easily be embedded into a preexisting website or course site. The Orientation site not only serves as an efficient segue to distance learning, but also proves to be an encompassing resource that can be referenced throughout distance learners' academic careers. Connecticut Distance Learning Consortium provides a collaboratively designed eportfolio platform to support learning, reflections, advising, career services, and assessment. Students use the platform to track and annotate their education, experience and goals. They can collect samples of their work to create portfolios and showcase specific experiences, photos, career documents, and portfolios to invited faculty, peers, employers, or others. A “counselor” view allows students to work virtually with advisors and career counselors.

At Saint Joseph's College of Maine, proactive academic advising for distance students meet the institutional goal of providing distance students with access to the same or better resources as their campus-based counterparts. Academic advisors maintain regular contact with prospective students via phone, mail, and email, and help students evaluate their academic and technical readiness for distance learning. Along the way, they encourage students to consider how their pursuit of distance education will fit into their family and work lives and to solicit support from family and friends. Students help students learn at Mercy College where students who have excelled in online courses become “wizards,” online teaching assistants. In Mercy College 's Master of Organizational Behavior program cohorts build online learning community as learners engage with permanent 12-month cohort of learners, with a permanently assigned mentor, and a permanent team of instructors; learners report a transformation in their academic, personal and professional development; and the program boasts a 90% success rate.

4. How can schools and faculty assess student satisfaction?

To make sure it provides a satisfying learning experience for graduate students, the Stevens Institute of Technology's WebCampus monitors student satisfaction and other responses every semester by surveying its online graduate students to find out how eager students are to learn and to be involved with their learning environment, how ready they are to collaborate with other students, and how at ease they are with their instructors. Students perceive that their learning is on a par with traditional modes and that the programs provide what they desire in graduate education.

Professor Denise Marchionda at the University of Massachusetts Lowell realized students would appreciate guidelines for managing the online week, so she provided a template for structured activities; students appreciate the guidelines and the distributed pacing of activities, and the template eliminates questions and reminders about the schedule.

5. How can schools increase student satisfaction with learning?

Learning designed for student satisfaction is convenient, flexible, relevant, personalized, and engaging; it offers learners options for learning activities and for controlling the pace of learning.

The University of Massachusetts uses the real-time case method to enhance the learning experience, providing extended, in-depth coverage to students at many schools, with real-time interactivity with the case company. Students report high satisfaction with the authenticity of the real case study work that sustains their interest and enthusiasm. Also at UML, a pause and post method improves the frequency and quality of discussion board posts in an education course.

Capella University students visit its online writing support center frequently and appreciate the writing tips featured regularly on its learning portal.

The Pennsylvania State University finds that learners enjoy ePortfolios as a way to evaluate their learning experiences and to share their reflections with peers and potential employers.

For designing and conducting large classes that are intellectually engaging and satisfying for students, Professor Murray Turoff of the New Jersey Institute of Technology provides tips for managing large groups effectively: synchronizing, organizing, socializing, collaborating, sharing and feedback.

At the University of Toledo, an online writing center increases satisfaction among students and faculty by helping students improve writing skills and avoid plagiarism.

6. How can schools use technology to enhance student satisfaction?

To create a website that intuits and satisfies expectations, Embry Riddle Aeronautical University surveyed its constituents and also invited visitors to give feedback on its website design and incorporated results to create a thoughtful web design that welcome current and perspective users. Another platform designed with users in mind, Moodle is an open-source learning management system designed by faculty with continuous feedback from users as a user-friendly interface for constructive interaction with content and classmates. Designed with a social constructionist framework, Moodle includes many features to enhance social, cognitive and teaching presence: user friendly overall design; easy course, user, and site management; assignment, chat, survey, forum, quiz, and resource modules; and wiki (collaborative

writing), encyclopedia, and glossary functions. Faculty at three universities—West Virginia University, University of North Carolina at Charlotte, and Virginia Tech—found that audio feedback enhances student satisfaction and saves faculty time. At American Public University (APUS), students use online collaborative document editors which streamline project workflows and improve cognitive outcomes because of easy collaboration, easy multimedia inclusion and manipulation, and the relationship between online document collaboration tools and wikis.

III. LEARNING EFFECTIVENESS

Sloan-C's goal for learning effectiveness is evidence that the quality of learning online is comparable to the quality of traditional programs, meeting or exceeding industry standards for learning outcomes. Metrics for learning effectiveness may demonstrate that:

- Interaction is key: with content, with instructors, classmates, the interface, and via vicarious interaction
- Online and traditional courses achieve comparable learning outcomes
- Online course design takes advantage of capabilities of the medium to improve learning (testing, discussion, materials)
- Communications and community building are emphasized
- Swift trust characterizes the online learning community
- Distinctive characteristics of programs are highlighted to demonstrate improved learning

Learning effectiveness online benefits from community efforts that help learners adjust their roles to become more aware of learning, more motivated and self-directed, and more confident in online environments. As Swan explains, learning effectiveness benefits from purposeful interaction; see Relationships between Interactions and Learning In Online Environments [3], a concise summary of the principles of interaction, many of which are exemplified in the effective practices listed here.

7. How can learning design enhance interaction?

Perceptions of learning effectiveness correlate with perceptions of social presence. At Florida State University, social presence begins with introductions in which students complete a personal profile complete with photo; profiles are accessible to the members of the course. Courses at the State University of New York University at Albany are designed for effective discussion management via modules for readings with critiques, lesson planning, and reflective journals that lead to abundant professor-student interaction.

For effective interaction, students and faculty benefit from clear expectations about communicating; clear expectations help manage the volume and quality of interaction. Thus, Prince George's Community College finds that improving navigation helps students find what they need and cuts down on questions to faculty. Clark College advocates front-loading content in course design so that students have already engaged with course work before they attend their first class meeting.

Across its curriculum, Mercy College finds that defining effective participation helps learners contribute postings that are: substantial (relate to the course material), concise (one screen may be the ideal message length), provocative (encourage others to respond), hermeneutical (expand concepts or connects ideas in new ways), timely (occur in a reasonable time frame—when the topic is under discussion), logical (support point of view with reasons and evidence), and grammatical (are well written). At Herkimer

Community College, Professor Bill Pelz encourages student-led discussion to build complex understandings of psychology concepts; discussions require postings that are relevant, important, thought-provoking, original and timely. Moreover applying research on presence to guide online discussions, Pelz helps students develop social, cognitive and teaching presence by grading for postings that document, explain and apply information that contributes to the understanding of some issue under discussion so that classmates gain insight into the subject, and learners become teachers.

Miami University finds that using the Quality Matters rubric to guide online course development, including emphasis on interaction, builds quality assurance into the final product. Emphasizing interaction (with content, peers, teachers, and interface [2]) aids collaboration, one of the most important aspects of online education; thus, a professor of education at Kent State University designs courses that include opportunities for both individual and group work via personalized instruction and problem based learning.

Second Life is a highly interactive virtual world that is proving engaging for faculty and students alike. Sloan-C describes how to hand out note-card directions in Second Life, and how to identify avatars by students' real names.

8. How can learning design enhance collaboration?

Asynchronous learning networks (ALN) optimize opportunities for collaborative learning and demonstration of learning. The University of Florida's Internet MBA uses online peer evaluation of writing assignments so that students give reciprocal feedback on each others' projects. For teachers in training, the University of Cincinnati's early childhood learning community uses multimedia for virtual assessment of and reflection on student teaching to enable students to do student-teaching in their own communities, and use online channels to self-evaluate, to obtain mentoring, and to create online journals and portfolios. At the University of Massachusetts Lowell (UML), professors in various disciplines use online resources to enhance learning. A UML education course uses electronic portfolios for organizing and assessing; each student builds an individual repository of materials, demonstrating industry and growth across a semester's worth of work. Portfolios help students and faculty demonstrate and track learning. At UML psychology professor provides a publication in personality psychology that integrates original writings of theorists, case studies and personality assessment inventories, so that students can apply, personalize and critique theoretical knowledge. UML accounting professors enable the practical application of accounting concepts using EDGAR, the Security and Exchange Commission's (SEC) electronic data gathering, analysis, and retrieval system so that students have meaningful illustrations and practical applications of financial reporting using actual SEC data. At Stevens Insitute of Technology professors use virtual teams for teaching marketing in an online course so that students learn experientially, doing actual marketing projects in collaboration.

A special collection of effective practices focuses on student-generated content as a special affordance of online learning that encourages active learning and demonstrable outcomes. At North Carolina State University, students enjoy electronic peer review for giving each other feedback, improving skills, and building on each other's work. At the University of Reading's School of System Engineering, students produce assessment learning objects to help each other learn programming. Minneapolis College of Art and Design showcases an online gallery of student and alumni work so peers and prospects can share inspiration. At Northern Virginia Community College students publish their own practical applications of math problems. Podcasting performances helps students develop skills in speaking English. At the University of North Carolina at Pembroke, students have created an Online Encyclopedia of Criminal Justice and gain experience "editing, revising, and organizing the content."

9. How can learning design inculcate academic honesty?

Adjustment to online learning includes understanding institutional policies for academic honesty and integrity. Florida State University applies the same honor code online and face to face. At the Virtual Academic Integrity Laboratory (VAIL), visitors to the online University of Maryland University College Center for Intellectual property find resources for faculty and administrators and for students. To verify identity, Pace University provides secure testing for online learners through a proctoring network.

10. How can schools assess learning effectiveness?

In the University at Albany's computer and media education courses, students participate in and learn to create lesson plans incorporating rubrics—not only do rubrics help assess student performance, by helping students focus on what matters in the course, they help refine the course and reduce questions about grades, easing faculty workload. Massachusetts Institute of Technology recognizes that a common objective scale for quality can benefit higher education efforts in joint development and shared resources, ultimately reducing the overall costs of online learning. Thus, MIT proposes a new methodology for evaluation: the pedagogical rating of online courses. This tool for overall evaluation of online courses or modules demonstrates that pedagogical effectiveness increases as cognitive opportunity increases, via attention to learning styles, media elements, and interaction. Michigan State University uses LON-CAPA, open source freeware for assessment and content management, to obtain immediate, detailed feedback about online homework, which can be used to quickly adjust lectures, recitation sessions, and individual help to address learner needs. The University of Wisconsin-Madison's Master of Engineering in Professional Practice has an integrated assessment system for courses, overall program and post-program career impacts that includes an evaluation of each course by students and faculty; an evaluation of the overall program at graduation; and a follow-up survey of alumni, their co-workers, and their family members to measure the impact of the program upon professional and personal development of alumni. The practice provides evidence of continuous improvement through regular team review and implementation of assessment results. At the College of Southern Maryland, professors incorporate assessment in three ways: 1) creation of a learning guide (explicit roadmap), 2) reorganized presentation and design, and 3) addition of classroom assessment techniques (CATs) in each course module. Students "welcomed the opportunity to participate in activities to assess their learning more frequently throughout the course."

11. How can technology support learning?

Learning benefits when relevant, active, interaction with content enables learners to apply skills and concepts. Technology offers options for simulations, online labs, and collaborations that support active learning. At Rio Salado, an online class helps students actively learn human anatomy using online resources such as interactive tutorials, tests, puzzles, practice labs, games, and written assignments. A course at Riverside Community College shows that outcomes improve when students have online access to elementary algebra with interactions, tutorials and workshops. Sheffield College boasts 100% success rates in its preparatory English certificate that helps students qualify for university entry. At William Rainey Harper College, a chemistry course includes a lab environment that demonstrates applications of theoretical concepts, including lab applications via blended learning, combining online and face-to-face learning. A course in ethics at the University of Massachusetts Lowell uses a mock trial to engage students in critical thinking about technology. Stanford designs custom tutorials using courselets, self-contained, integrated sets of learning materials for unlimited practice and review to enhance the learning experience for students and reduce the demand for faculty time. At Indiana University, the TALON Learning Object System provides repurposeable learning objects that faculty can easily adapt to create interactive content for writing, visual learning, math and more so that students can master skills and content. The University of Vermont College of Medicine transformed traditional education with an

integrated curriculum that includes a wide variety of multimedia educational technology tools and applications for hybrid learning environments, including reusable learning objects, virtual reality models, streaming audio and video, and online exams. Because students interact with the self-directed, online educational tools at their own speed on their own time, prior to attending face-to-face lectures, faculty have been more efficiently focusing their face-to-face time with students in class. At Carnegie Mellon, speakers of English as a second language use an automated reading tutor that listens (Project LISTEN) and "intervenes when the reader makes mistakes, gets stuck, clicks for help, or is likely to encounter difficulty." Kansai University receives positive evaluations from students who receive lectures at home via 3D virtual space.

WGBH PBS models rich multimedia content that is both educational and entertaining in its Nova program *The Elegant Universe* — each segment provides online transcripts, assignments, animations, interactivities, links to related sites and references, technical support, cinematography, narrative, video clips, and audio including music.

IV. SCALE

Scale enables institutions to offer their best educational value to learners and to achieve capacity enrollment. Scale in online education is often a reflection of institutional commitment to providing quality online, so that online education achieves outcomes that are at least equivalent to outcomes achieved in other delivery modes in ways that are affordable for providers and for learners. In many cases, as the practices listed here demonstrate, online programs create efficiencies for "avoiding, reducing, and conserving costs" [4] that exceed those in traditional modes. An overview of issues institutions face in scaling online programs is provided by Oakley and Moloney [5].

- Institutions continuously improve services while reducing cost to achieve capacity enrollment
- Cost effectiveness models are tuned to institutional goals
- Tuition and fees reflect cost of services delivery
- Scalability, if an institutional objective, can be accommodated
- Partnering and resource sharing are institutional strategies for reducing costs
- Mission-based strategies for cost reduction are continuously formulated and tested
- Intellectual property policies encourage cost effective strategies

12. How can schools share resources to improve learning and avoid costs?

Consortia and other partnerships offer institutions opportunities to improve quality by sharing knowledge, resources and costs. In the Virtual Library of Virginia (VIVA), 39 state-supported colleges and universities in the Commonwealth of Virginia use technology to improve learning and productivity, and at the same time avoid costs (estimated $74.5M) by sharing library resources online. WISE Web-based Information Science Education) is a collaborative for sharing library and information science resources. The Colorado Community Colleges Online share the costs of online services including student admissions, records, advising, and bookstore. Business schools at four different universities from Canada to Florida collaborate in using the real-time case method (RCTM) to enhance learning and reduce costs —RCTM is scalable to more universities.

13. How can redesign improve access, affordability, and learning, and save effort?

Re-designing courses can improve learning and access, free up faculty time, reduce physical plant costs, reduce dropout, failure, withdrawal (DFW) rates, and maintain or increase enrollment. The Pew Course Redesign Project demonstrates how substitutions of technology for labor increase access, achieve cost savings, and utilize technology to facilitate learning. In courses in multiple settings, universities are able to reduce classroom space and contain costs or achieve some cost savings by substituting a primarily asynchronous learning model for the traditional classroom model.

A redesigned computer literacy course at the University of Buffalo produced 54–60% reductions in cost per student. An introductory psychology course at University of Southern Maine reduced lecture time, increased interaction and completion rates, and reduced cost per student by more than 50%. At the University of Dayton, redesign reduced course sections of introductory psychology by 50% by combining sections with more collaborative and interactive learning models. At Brigham Young University, redesigning Freshman Composition resulted in less time in class, greater interaction, and maintained learning outcomes and satisfaction; Vanderbilt University's distributed learning electronics labs increase access and decrease the number of trips to a physical lab at a reduced cost. At Virginia Tech, an online math course eliminates class meetings, maintains learning outcomes, and improves completions. At the University of Iowa, a redesigned chemistry course enables students to report homework and laboratory results online, with a cost savings of about $10 per student. Indiana University-Purdue University Indianapolis lowered the cost of introductory sociology by about 20% while improving learning outcomes and completion rates. An introductory Spanish course at the University of Tennessee Knoxville reduced faculty workload by automating grading; the redesigned course increased enrollment and achievement. The Pennsylvania State University redesigned an introductory statistics course with a 30% reduction in cost per student, reducing lecture and preparation time, adding computerized testing, and increasing interaction. Faculty at West Chester University improved instruction and reduced workload by introducing a virtual biology laboratory. Western Kentucky University's self-paced, web-based computer literacy course reduced cost per student by two-thirds while increasing enrollment more than threefold. The University of Central Florida redesigned a course in American National Government, and anticipates annual cost avoidance of $70K in physical space while increasing collaboration and interaction. With the addition of a teaching assistant, Rio Salado redesigned math courses to reduce faculty staffing and increase enrollments with a decrease in per student costs of 37%. The University of Maryland University College introduced interactive faculty training via CD-ROM to provide a standardized, high-quality, flexible, and reusable delivery mechanism to worldwide faculty in its more than 3000 sections of faculty training; its online faculty development workshops emphasize direct application so faculty can immediately implement what they learn.

14. How can schools use technology to improve strategic planning?

At The Pennsylvania State University, cost effectiveness means balancing educational outcomes and costs, thus The Pennsylvania State World Campus adopted a budgeting system that includes the costs of faculty compensation, instructional design, faculty development activities, marketing, and student services administration. The University of California, Davis compares face to face and online courses for cost-effectiveness and student pass rates, linking student learning outcomes with development and delivery costs. Central Virginia Community College has a comprehensive plan to enhance the quality of online education via assessment and five-year goals. Michigan State University's Office of MSU Global created an effective 5-phase business planning and costing model that streamlines the development and implementation process for online degree and certificate programs; its program costing model aims to ensure return on investment; and its global academic business planning model helps plan and implement

hybrid degree and certificate programs in partnership with international higher education institutions. Florida State University's Office for Distributed and Distance Learning created an About Online Learning @ FSU website that features snapshots of online learning data under six categories that reveal a variety of information about FSU's courses, students and instructors related to FSU's online degree programs. This website has become a tool for reflective and demonstrative purposes that can ultimately lead to teaching and learning improvements and for strategic planning. At the University of North Texas, the Quality Enhancement Program is an ongoing process for accreditation that "meets all five pillars of quality by providing access to information about the QEP through presentations to thousands of faculty and students, student satisfaction in knowing that the university is focusing much effort into improving the undergraduate experience, learning effectiveness in engaging students in active problems-based learning, faculty satisfaction in being empowered to unleash their creativity and do what they do best - share their passion for their subject matter, and cost effectiveness and institutional commitment in providing an institution-wide focus on making big classes better."

15. How can schools use technology to provide cost effective services for faculty, students and administrators?

Kentucky Virtual University planned for effectiveness and efficiency by creating a one-stop shopping portal that collocates admissions, registration, resources, the virtual library (KVL), the virtual high school (KVHS), and adult education (KVAE). Duquesne University provides important financial information to students by listing the various funding options on its tuition web page. The Pennsylvania State University's comprehensive academic advising and information system saves approximately $1M and considerable transaction time while giving students more responsibility for learning. Florida State University created an efficient and user-friendly test proctoring process that reduces duplications and eliminates the need to mail exam materials to proctors. At Pace University, secure testing and asynchronous faculty and curriculum development tools provide support to faculty, and curriculum development projects improve student and faculty satisfaction with little or no additional cost. An online faculty staffing tool is a more efficient means of scheduling faculty course assignments at the University of Maryland University College. The Rochester Institute of Technology's History Department cost effectively built an online course with free materials and, in the process, created an online inventory of resources that are freely available online for other educators to create web-enhanced, blended or fully online humanities and social science courses.

V. ACCESS

Access for anyone who is qualified and motivated to pursue studies calls for administrative and support services and for more choices for more learners and more kinds of learners. Thus effective practices in access show how organizations facilitate learning opportunities in large and small ways.

- Diverse learning abilities are provided for (at-risk, disabilities, expert learners)
- The reliability and functionality of delivery mechanisms are continuously evaluated
- Learner-centered courseware is provided
- Feedback from learners is taken seriously and used for continuous improvement
- Courses that students want are available when they want them
- Connectivity to multiple opportunities for learning and service is provided
-

16. How can specialized online student services and resources make access easier?

Pace University supports students with online support services, including math tutoring, and measures the effectiveness of these services.

The University of Phoenix provides one-click access to student services and resources directly from online courses.

Saint Leo University provides online access to community-building activities and opportunities.

Community College of Baltimore County, Essex offers a "walk through the web" course in several formats to introduce students, faculty and staff to all of the services that are provided on CCBC-Essex's web site.

Connecticut Distance Learning Consortium provides eTutoring.org, a collaborative program and platform that shares tutoring expertise among member institutions, thus giving students access to more support.

Kentucky Virtual University (KYVU) enables students from participating institutions to register for KYVU courses using common application and registration forms.

The Pennsylvania State University responds rapidly to users, emphasizes service, and projects a distinctive identity through its website that provides a smooth connection to information, programs, and services.

For a highly mobile learner population, GoArmyEd provides U.S. Army Soldiers unprecedented access to all the resources needed to pursue higher education while simultaneously serving in demanding work environments.

So students can get information any time, Maryland AskUsNow is a 24/7 live online interactive library service that uses the expertise of librarians to provide Maryland residents with answers to questions, research guidance, and help navigating the Internet. The University of Maryland University College 's electronic document delivery service allows UMUC students and faculty to access journal articles and book chapters. At Davidson College, open access to scientific journals online means more equitable access, and using primary published research results can enhance student learning by developing critical and other higher-order thinking skills.

To ease and speed admission processes, Saint Leo University reports transfer credit rapidly from its data base of thousands of sources of equivalencies and provides degree completion program outlines quickly. For students who want customized learning help, SMARTHINKING provides anywhere, anytime tutoring in real time one-on-one online tutoring services to students. Pace University provides a tip for enhancing access— use mid-week start/end frames for assignments; at Pace, working adults prefer mid-week rather than weekend due dates.

At New Jersey Institute of Technology, Professor Murray Turoff designed a one room schoolhouse so that students can choose to attend blended or face to face sections of the course.

17. How can schools help students access support and adapt to academic culture?

When students decide to enroll, Boise State (BSU) helps them visualize the enrollment procedure via an online flowchart; BSU's "boot camp" is an asynchronous online training program that prepares students for succeeding online. Northern Virginia Community College provides many ways for prospective students to find out about courses; before enrolling; its continuous enrollment and expandable course sections help meet growing learner demand for more access. The State University of New York Learning Network (SLN) provides learners and faculty access to online learning communities as critically important learning resources.

Access also means that students are aware of choices and resources, thus Fairleigh Dickinson seeks to meet its objective to create skilled lifelong global learners by requiring all of its undergraduates to take online courses. Pace University's university/industry partnership with CAEL, the Council for Adult and Experiential Learning and the telecommunications industry provides access for telecommunications employees and their employers. Maryland Digital Library (MDL) provides online electronic library resources to Maryland higher education institutions. Rice University connects graduate students to virtual guests in asynchronous discussions, enabling students to interact with experts, expressing individual concerns and discussing them without time and place constraints. Two pilot projects at the University of Helsinki demonstrate the potential of mobile Learning to increase access to learning opportunities and resources. Once students are enrolled, access includes helping students make education more affordable, thus Embry-Riddle Aeronautical University makes buying and selling used textbooks online easy.

18. How can schools provide access to special populations?

The University of Washington's DO-IT (Disabilities, Opportunities, Internetworking, and Technology) Center makes distance courses accessible to students with disabilities, provides resources about accessibility online, and promotes the accessible design of online courses nationwide. The Western Cooperative for Educational Telecommunications provides students, researchers and administrators with guidance for time- and location-independent support and information services, including academic advising, career planning, financial aid, library services, orientation, personal counseling, tutoring, disability services, call centers, and for re-engineering student services. An exemplar of such services is Rio Salado, which uses a systems approach to online learning: its integration of the activities of course development and support, student services, faculty services, information services, admissions and records and marketing departments makes Rio able to offer students hundreds of unique courses, with 90% of the courses available for students to enroll in every two weeks (twenty-six start times per year), with the remainder of the courses usually available for enrollment six to eight times per year. Rio never cancels a class, even if only one student enrolls. James Madison University provides summer online courses so that students can meet their graduation requirements when courses are inaccessible during the Fall and Spring terms on campus.

Access to learning for specialized populations of learners occurs in various discipline-based courses with practices that might be adapted or use across disciplines, like these in:

Business:
FCIB, an association of executives in finance, credit, and international business, and Michigan State University Global (MSU Global) formed an innovative partnership that applies an instructor-led, cohort-based model for corporate online learning and leads to certificates in international credit and risk management. University of Central Florida provides a 3-D Interactive Accounting Model that motivates

students to understand and manipulate inputs and outputs. At Ohio State University, a Statistical Buffet gives students choices for their own mix of activities for learning the same set of course objectives. Using automated course administration and individualized web content optimizes each student's experience and improves success rates. At Morrisville State College an IT internship provides field-work in a selected business, industry, government or educational setting. This real-world work experience gives students "increased confidence in their own technical abilities. To date, more than 90 percent of interns have received offers of full-time employment by their internship sponsor."

Education and Computer Science:
At Harvard University, modeling experiential learning and exemplary standards helps learners use various pedagogies, media and technology to improve learning. Rice University connects teachers in training with virtual guests who are expert teachers through asynchronous discussions; virtual guests can host asynchronous interactive discussions and students can interact with them expressing individual concerns without time and place constraints.

At the University of Massachusetts Lowell, a course in theory and research in curriculum keeps students current with virtual textbooks, web hot spots, and weekly newsflashes. The University of Virginia provides virtual electronics laboratories using visual representations of microelectronics devices to help students internalize concepts.

The University of California-Riverside (UCR) Graduate School of Education uses electronic portfolios in its teaching credential program. To foster students' critical thinking and interpersonal skills, and enable students to make connections between service and their academic work, Bemidji State University's Distributed Learning in Teacher Education (DLiTE) program uses e-service for experiential service learning opportunities in online courses. At the University of Illinois, Urbana-Champaign, the Library and Information Science program creates a significant difference in the way students participate in a rapidly changing profession, including helping learners is to create a community of practice in the new online environment.

San Francisco State University conducts a learn-by-doing course in Training Needs Assessment in which teams of students perform needs assessments for real clients in corporate, non-profit, higher education, and K-12 education settings.

Engineering:
The University of Toledo's (UT) collaborative partnering approach enables UT to offer engineering technology online degree programs statewide.

Stevens Institute of Technology, in partnership with several scholarly global organizations, provides graduate engineering certificate programs online.

Environment:
The University of Wisconsin-Stevens Point (UWSP) Extension offers environmental studies online and in hybrid formats.

NOAA's interactive course: Collaborative Processes, is self-paced series of interactive modules explores roles and processes, stakeholders, meeting and conflict management, and assessment of task/process behaviors can help identify individual and collective styles.

Health:
Creighton University provides a Doctor of Pharmacy degree, expanding access to underserved populations in rural areas that are not within driving distance of a place-bound pharmacy school. Rochester Institute of Technology, in conjunction with the Monroe County (NY) Health Alert Network (HAN) and the New York State Association of County Health Officials (NYASCHO), funded by a grant from the Centers for Disease Control (CDC), offers instructor-led online learning for adult voluntary learners who need job-related training.

Humanities:
Integrated Medical Curriculum (IMC) provides The Doctor's Dilemma, an interactive medical ethics role-playing program that uses text- and photo-based material to explore "complex or controversial issues found in contemporary medical practice" through role-playing.

Minneapolis College of Art and Design's Distance Learning Initiative re-creates the studio-based model online for art and design education.

Goucher College's MA in historic preservation is a hybrid program that requires one in-person introductory meeting.

Boston Architectural Center offers online professional design education, a field which relies on expressive representation, subjective interpretation, and critique in a wide range of graphic, verbal and quantitative media.

Science:
Western Washington University's integrated laboratory network (ILN) provides better access to scientific instrumentation and expertise anytime, and from anywhere by allowing students and researchers to operate instruments located at different campus locations via the internet. The ILN also enables direct exchange of information, data, and classroom material, modeling the virtual laboratory of the future, enabling learners and teachers to apply the philosophy that science is a dynamic, iterative, ongoing, and collaborative process. Northern Virginia Community College provides chemistry laboratories for science majors using home laboratories, computer exercises, field trips, and college laboratories to improve access and learning experience. The University of Colorado at Denver (UCD) offers lab-based science courses in online and hybrid formats for anytime anywhere chemistry experiences.

19. How can schools use technology to improve access?

Training users and employing technologies that simplify operations eases access for various constituents in organizations. The University of Illinois - Springfield facilitates technical support with screen capture software, GifgIfgiF, that animates software demonstrations; and it uses Impatica to reduce the need for plug-ins, converting PowerPoint lectures into streaming Java presentations. Duquesne University enables learning-on-the-go for access to course and study materials so that busy adult students can listen to audio recordings any time via MP3. Washington State University 's Distance Degree Programs uses streaming technologies to publish course descriptions, faculty bios and student testimonials in close-captioned streaming audio with revolving photos, allowing students an opportunity to quickly and easily see and hear the fine details of WSU-DDP online courses. At Atlantic Cape Community College, faculty-staff-student partnerships produce reusable and shareable learning objects. Distance learning faculty specialists bridge the gap between faculty and administration through the Distance Learning Faculty Specialist (DLFS) model, developed by Eastern Oregon University to help involve faculty in distance education.

The University of South Queensland (USQ) is building strategically planned, systematically integrated, institutionally comprehensive implementation of information and communication technologies including automated responses, intelligent object databases, and other information and communication technologies, including automated response systems and intelligent object databases to automate certain aspects of interaction with students, increasing access to higher education on a global scale. At San Francisco State University, some courses use the "HyFlex" course and design process so that students may choose to attend face-to-face synchronous class sessions or complete course learning activities online without attending class in person.

VI. FACULTY SATISFACTION

Faculty satisfaction with online teaching reflects institutional commitment to building and sustaining environments that are personally rewarding and professionally beneficial. The practices listed here include resources and strategies for ensuring faculty success.

- Faculty satisfaction metrics show improvement over time
- Faculty contribute to, and benefit from online teaching
- Faculty are rewarded for teaching online and for conducting research about improving teaching online
- Faculty experiences, practices and knowledge about online learning is part of the institutional knowledge sharing structure
- There is a parity in workload between classroom and online teaching
- Significant technical support and training are provided by the institution

20. How can schools foster greater community among faculty?

One of the great benefits for faculty who teach online is the opportunity to connect with new communities. Within these communities, quality is a frequent topic for discussion, activities and resource sharing. Maryland Faculty Online provides affordable faculty technology training via the Faculty Online Technology Training Consortium (FOTTC); its Project Synergy is a collaborative effort to train Maryland faculty in the 23 higher education institutions. FOTTC gathers, reviews, enhances, and disseminates interactive, technology-based, Web-accessible learning objects for use in key discipline areas. The project has enabled faculty to develop a repository of over 100 Web-accessible learning objects in six key discipline areas; the learning objects are enhanced with assignments, assessments, and instructions for using these learning objects effectively. The project has also developed models for enhancing learning objects in the disciplines. The project helps to establish the Maryland Faculty Online web site as the statewide web-based training center for the ongoing professional development of faculty. The University of Calgary's best practices in e-learning online showcase enables practitioners in e-learning to meet, share and showcase their best practices with each other. University of Illinois at Chicago (UIC) and Great Cities Institute integrate adjunct faculty into the community of practitioners through activities and incentives. The University of Massachusetts Lowell promotes faculty collaboration through an online faculty book club; the book club enables faculty to discuss issues and share effective practices. Florida Community College at Jacksonville Distance Learning uses a virtual mentoring program to support online adjunct faculty with instructional and technical support and to liaise between faculty and Virtual College staff. At the University of Massachusetts Lowell, veteran online faculty mentors become cyber-celebrities and guest speakers who interact and share their experiences with faculty new to online teaching and course development. George Mason University created a faculty fellows program to increase faculty skills and interest in online education and to provide social and technical support. Florida State University recognizes faculty as WebStars and publishes their effective teaching tips on special web pages for

sharing knowledge about using technology to improve quality of instruction. California State University, Chico provides an online rubric for online instruction to demonstrate and encourage exemplary faculty work in online education.

Members of online communities can stay abreast of the rapidly changing environment and apply information to the development of their online offerings by subscribing to University of Illinois Springfield daily blogs on new and developing initiatives, methodologies, and technologies in ALN.

21. How can schools prepare faculty to teach online more effectively?

Faculty preparation for teaching online measurably improves learning effectiveness and satisfaction. Thus, because learning effectiveness also focuses on faculty, The Pennsylvania State University provides a self-paced faculty development program that helps faculty understand distance education students; recognize how distance education differs from traditional resident instruction; determine course goals, learning model, and content; determine course assignments, interactions and assessments; choose delivery technology; and understand legal issues in course design. The program includes guidelines for clear communication and netiquette. Another useful self-paced teaching aid is the Learning to Teach with Technology Studio (LTTS) at the Indiana University (IU) School of Education. This program offers K–12 teachers forty five online courses that include email facilitation and a standard course structure. The structure of courses is described in an online IU tour:

- Problem: Introducing the problem
- Process: How to go about solving the problem
- Solution: Completing the course project
- Assessment: How your work will be assessed
- Resources: What resources are available to help you

To enable faculty to design courses and control the quality of content, schools and organizations provide training and resources. At Berkeley College, faculty training and support are available totally online.A four-stage faculty development process, created by State University of New York Learning Network, leads to high faculty satisfaction with teaching online. The Monroe Model, created by Monroe Community College, is a site-based and online support framework that addresses any issues or questions faculty might face. CoreOnline at Boise State University is a graduated faculty development model, in which teams of faculty learn online instruction skills and practice them as they collaborate on the development of a targeted general education core course. At University of Nebraska Lincoln's Extended Education and Outreach, a five-week online summer faculty development program of training for online teaching takes both novice and experienced online instructors through the steps of course development and management, online teaching, and online assessment. The Berkeley College Online Faculty Resource Center is a media-rich interactive site that provides faculty with comprehensive resources. Catalyst is the University of Washington 's online faculty guide to distance teaching ; Catalyst uses multiple feedback mechanisms (e.g., focus groups, online evaluations, surveys, usability studies, e-mail and face-to-face comments) to assess its effectiveness and overall impact. The learning to teach online program (LeTTOL) program, created by South Yorkshire Further Education Consortium, helps participants gain the skills they need to develop and deliver online courses. At Dallas Baptist University, an online teaching tips website is open to public use and commentary. Faculty teaching online find that knowing behavior patterns improves teaching and learning, thus researchers at the University of Central Florida design learning activities and interaction to correspond to learners' energy levels, need for approval, and styles of dependence and independence. For teachers in training, a professor at the University of Central Florida shows students how to create digital stories that help teachers learn to use multimedia and their students to learn vocabulary.

North Carolina State University Distance Education and Learning Technology Applications (DELTA) RFP Program, created by North Carolina State University, funds faculty in the planning, design, and development of distance education programs.

22. How can schools encourage and support research opportunities for faculty?

In the relatively young field of online education, faculty and others enjoy opportunities for research and publication. The Indiana Partnership for Statewide Education has assembled guiding principles for faculty in distance learning online to help faculty members teach courses online. The Greater Detroit Area Partnership for Training improves faulty satisfaction with its analysis of faculty experience and standards of excellence that addresses concerns identified by faculty feedback.

23. How can schools recognize and reward faculty who teach online?

Studies like the above can lead to initiatives that improve faculty satisfaction by rewarding faculty for their achievements in development, research and teaching online. In its ongoing study and enhancement of faculty satisfaction, The Pennsylvania State University World Campus implements three principles to study and enhance faculty satisfaction: proactively and continuously managing expectations, distinguishing between "real" and "perceived" problems, and identifying and targeting the locus of control and change; its multidimensional UniSCOPE model for review of scholarly activity recognizes and rewards faculty for online activities. Northeastern University's Center for Innovative Course Design rewards faculty through student-nominated faculty awards for effective and innovative technology use — faculty receive recognition for effective or innovative use of technology to support good teaching and learning; students feel empowered by nominating examples of effective practice. Auburn University has fundamentally transformed its tenure and promotion process giving faculty more freedom of choice for spending time and resources. And Indiana University Purdue University Indianapolis includes technology scholarship in its faculty reward structure for the use of technology for teaching and learning.

24. How can technology help organize and enhance faculty activities?

Technology enables rapid distribution, integration, and feedback of information that can lighten faculty workload. Uni Open Platform for instructor support and workload management, created by FernUniversitat Hagen, automates administrative processes, allowing faculty members to spend more time supporting and advising students.

A professor at the University of Maine at Fort Kent continuously improves his syllabus, incorporating and publishing results by annotating the syllabus during course delivery; using feedback for reflecting, evaluating, and planning ahead; and by documenting and sharing the improvements made to his course. At Athabasca University, faculty members can update their materials themselves via their browsers with the use of blogging software with an estimated 90% reduction in the time usually taken to update online course materials from two weeks per semester to one day; to keep the community current with tools, Athabasca graduate students compare the growing array of LMS software at http://cde.athabascau.ca/softeval/. Berkeley College uses Intranets Conferencing, a commercial service that enables faculty to confer online and develop or modify an online course, incorporate media, and have their questions, problems, and concerns attended to quickly and easily anywhere and any time. At the University of Houston (C.T. Bauer College of Business), faculty share ethics learning objects to save faculty development time.

The Learning Online Network-Computer-Assisted Personalized Approach (LON-CAPA), developed at Michigan State University, is open source software that enables instructors to create computer-assisted personalized assignments, quizzes, and examinations.

The Multimedia Educational Resource for Learning and Online Teaching (MERLOT) peer reviews online teaching-learning materials and publishes materials online, making them freely available to faculty everywhere.

VII. CONCLUSION

The practices in this synthesis may be refined for local contexts and adapted across a wide range of institutions. Thanks to the generosity of effective practices contributors, the questions in this synthesis identify some ways asynchronous learning networks are transforming higher education. Yet, the questions are by no means comprehensive, and the practices suggest a multitude of innovations still to be developed and shared. Readers are welcome to add questions and comments, to build on these ideas, and to contribute more practices to Sloan-C Effective Practices so that the goal of quality, breadth and scale in any time, anywhere education becomes a reality for more learners than ever before possible.

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A MODEL FOR DEVELOPING HIGH-QUALITY ONLINE COURSES: INTEGRATING A SYSTEMS APPROACH WITH LEARNING THEORY

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ABSTRACT
As the demand for online education continues to increase, institutions are faced with developing process models for efficient, high-quality online course development. This paper describes a systems, team-based, approach that centers on an online instructional design theory (*Active Mastery Learning)* implemented at Colorado State University-Global Campus. CSU-Global Campus is a newly-created online campus within the Colorado State University System, and launches in Fall 2008 with fully-online undergraduate degree completion programs and Master's degrees.

KEYWORDS
Online Course Development, Instructional Design, Online Faculty Development

I. INTRODUCTION AND OVERVIEW

Developing or creating an online course is a highly complex and multifaceted process. There are several levels of "development" that need to occur, and no one person is likely capable of discharging all of the expertise levels and roles inherent in the process. In order to meet the growing demand for quality online education, a course development model that provides a common framework for consistency, design, pedagogy and content can be very effective.

The notion of collaborative course development is well-described in the literature, in the context of team dynamics, instructional design, and course quality [1, 2, 3, 4, 5]. Institutions such as Park University, which employs a standardized online course development model incorporating collaborative efforts among faculty and instructional design staff, have reported positive results [6]. The model presented in this paper also uses an integrated, collaborative model for development, but is aligned with Active Mastery Learning, an instructional development theory being refined and tested at CSU-Global Campus.

We begin from the assumption that collaboration provides an optimal environment for developing rich, dynamic, and interactive online courses. In addition, we acknowledge the need for a sustainable "business model" for online course development that offers a scalable production process that is the foundation for quality, efficiency, and productivity for the entire institution. However, online courses are not widgets; rather, they are learning experiences, and so the proposed model incorporates learning benchmarks and best practices for online pedagogy, conceptually aligned with Bloom's Taxonomy and practical implementation of Quality Matters criteria [7]. Creating the team culture, defining the learning vision and

framework, identifying the resources, and crafting the production workflow for effective teamwork are all critical planning elements for administrative leadership.

Worth noting is that the degree of collaboration described in this model does require significant institutional commitment in terms of resources, staff, technological tools, and overall effort. However, institutions can adapt this model in multiple ways; for example by appropriately scaling the size of teams, the use of part-time staff or dual roles to fulfill specific team roles, or allowing longer course production times.

This paper will examine the collaborative online course development process from an administrative perspective, and present a systemized approach to developing, implementing and managing high-quality, streamlined online course production.

II. THE BUSINESS MODEL

Online course production does not occur in a vacuum. The system, processes, and workflow are driven by the "business functions" of the institution, which include consideration of the research, the market demand, the market expectations, and the course distribution plan—and building in the flexibility to adapt to market, technology, and fluctuations. As Greenberg [8] powerfully points out, universities are indeed businesses, and if they are to compete in the ever-growing competitive online higher education market, they need to take a hard look at their culture and practices. This must occur at all levels, and most importantly, in the instructional realm, where semesters are no longer 16 weeks, faculty are no longer the only "experts," and the classroom is no longer time and place-bound.

In order to compete in the online higher education market, quite simply, institutions need to get relevant, high-quality product to market quickly. It is no longer feasible to have 18–24 months course production time, and to leave the format, navigation, and look and feel of the final course product to the discretion of each individual course developer. In a market where students expect fast service, consistency, and quality, a more streamlined production approach is now required.

High-quality online course development and delivery are essential goals to the fundamental mission of CSU-Global Campus. As such, the investment in quality, faculty support, and instructional development staffing enable the model described in this paper. The most recent Sloan-C report indicates that approximately three-quarters of respondents from public instructions reported that online education is critical to the long-term strategy of their institutions [9]. The integration of online education into the institutional strategic planning and goal-setting process is critical to achieving the level of quality needed to complete in the competitive industry of online education.

It is also important to emphasize that course developers are customers, too—and this is has become a competitive market. In a market where there are abundant job opportunities for online course developers and faculty, institutions must retain the best workforce to be become and remain competitive while providing quality online course materials. Faculty and other subject matter experts (SMEs) have high expectations about the process, support, expectations, and workload involved in online course production.

The online course production process must take into account the distribution plan; in other words, to whom and where will the courses be distributed? Courses are being developed for delivery to a global audience, and quite possibly, in high volume. Even institutions that are tentatively venturing into the

online realm, building a process that can handle volume will save time and effort later and support scalability.

The course production framework must also be flexible enough to adapt to changes in technology, student and faculty evolving expectations, new research in the field of online pedagogy, and curricular changes. For this reason, we recommend a concurrent course revision and maintenance framework that constantly compels the production team to quantitatively and qualitatively assess the efficiency of the framework, and maintain the flexibility to make adjustments as needed.

In sum, the business model of course production is a framework, but should be flexible and dynamic.

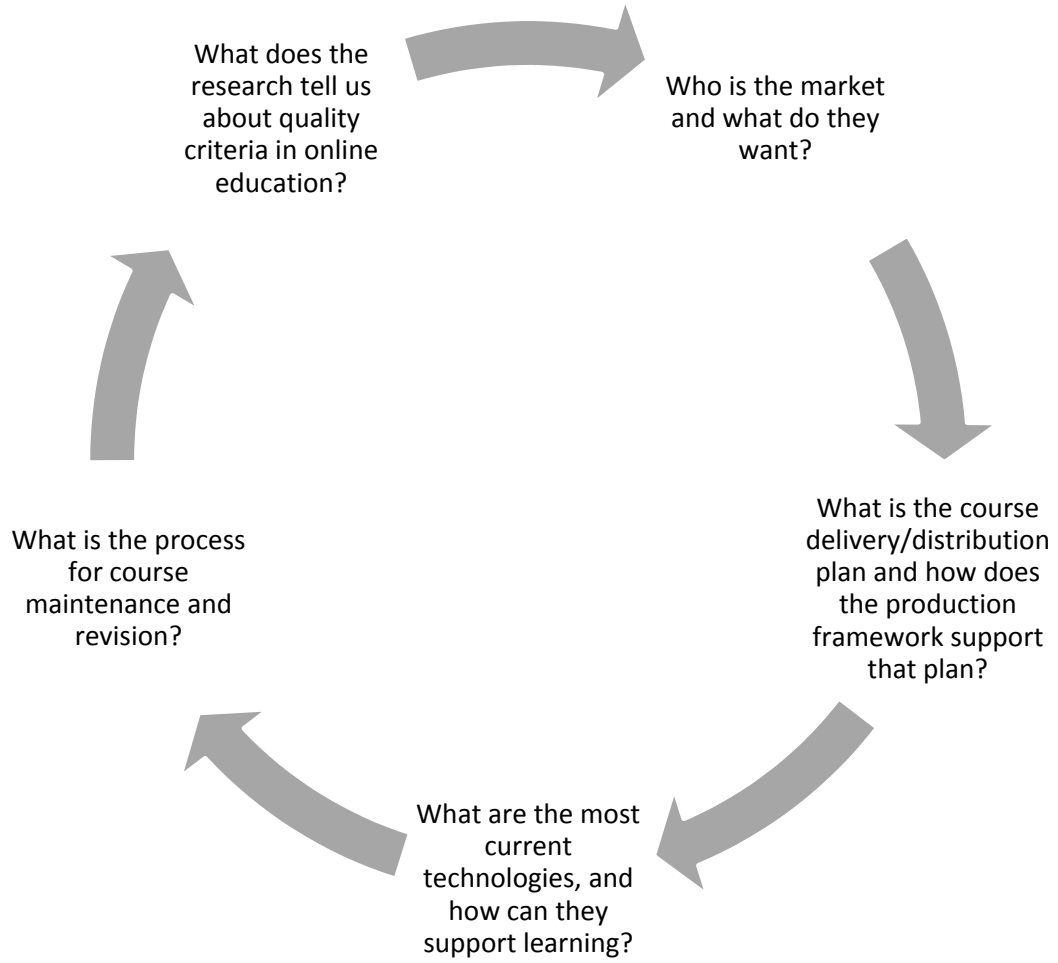

Figure 1: Online Course Production Framework: Guiding Questions

III. DEVELOPING THE QUALITY VISION AND COURSE DESIGN STANDARD

It would be naïve to propose a production process such as this without considering the political and cultural context of higher education. Academic freedom and faculty governance structures create a

cultural framework that necessitates some adjustment of the processes outlined in this paper. However, all can likely agree that academic quality is still at the heart of what we do. And, one of the primary jobs of the online education administrator is to develop a working relationship with faculty based on a mutual recognition and respect for the not necessarily mutually exclusive guiding principles of course consistency and academic freedom.

At the very core of "quality" is the principle that pedagogy must be the driver of the production process, not technology. Although technology is certainly an important consideration, it should always support the learning goals and objectives at both the program and course levels. There is general agreement of this principle in the literature [1, 2, 10]; however, in practice the technology can often be very alluring to creative and innovative instructional development teams--but technological bells and whistles will not replace good pedagogy. Figure 1 outlines the guiding questions for the process as a whole.

Before the production framework and process can begin, it is critical to have a vision of quality and a course design standard derived from this vision. The standard must be documented in such a way as to clearly communicate to the course production team the design expectations and the specifications for the deliverables. Documentation can include a sample course, a spreadsheet of course elements, and/or a rubric. Often, we get bogged down in rubrics, technical specifications, and checklists and lose the "vision" for quality. To help the team stay focused on that vision, we recommend having a quality vision statement that is used to guide the team, such as the one below:

> *Quality online courses are well-organized into learning units; have clear learning goals and objectives; include materials and activities that directly support the learning goals and objectives; engage the learner through interaction with content, other students and the instructor; and offer rich and relevant resources for students. Most of all, online courses should be fun, engaging, pedagogically sound, and relevant.*

The vision statement should be grounded in theory, and clearly defined in an operational, as well as conceptual way. Our learning model is *Active Mastery Learning*, which begins from the assumption that the course to be developed is not just flat, one-dimensional "content"—it is a series of learning environments and activities. Effective learning motivates learners, engages them through communication with each other and the instructor, develops their skills, and enables learners to transfer their new skills to other settings. The classic Seven Principles of Good Practice, adapted to technology illustrate the principles of quality in education [11]:

1. Good Practice Encourages Contact Between Students and Faculty
2. Good Practice Develops Reciprocity and Cooperation Among Students
3. Good Practice Uses Active Learning Techniques
4. Good Practice Gives Prompt Feedback
5. Good Practice Emphasizes Time on Task
6. Good Practice Communicates High Expectations
7. Good Practice Respects Diverse Talents and Ways of Learning

Virtually all educators agree that the Seven Principles of Good Practice represent an excellent starting framework for developing a vision of quality. We begin the *Active Mastery Learning* foundation here also, and emphasize the guiding belief that all students can learn when the learning environment is active

and authentic. Learners must be engaged in the experience, not just the exercise, of learning.

Thus, authentic learning is an important part of the vision of quality for the course, and emphasizes the importance of creating course activities that actively engage students in exploring, discussing and analyzing abstract concepts in real-world, relevant contexts [12]. Lombardi [13] provides an excellent overview of authentic learning, its importance to today's students, and examples of specific exercises and strategies for building authentic learning into online course environments. These activities include simulations, student-created media, inquiry-based learning, and peer-based evaluation.

We believe that constructivist, active and authentic activities are most effective, and the general agreement in online education is that "active" and community-based virtual environments are the most favorable for both student satisfaction and learning outcomes. However, students must also master content in order to meet certain competencies.

Bloom's taxonomy explains learning as a progression from simple learning to the higher levels of critical thinking, as illustrated in Figure 2 [14]. Mastery learning can be conceived of as an instructional philosophy—at the core is the belief that all students can learn, if given the time and opportunity. Not all students move up the ladder of Bloom's Taxonomy at the same pace, but the core belief is that they can. Mastery learning also does not focus on the content, but focuses on the process of mastering the specific learning objectives tied to the content.

However, mastery learning is just one piece of the puzzle. In a recent study of the effectiveness of mastery learning, Kazu, et al. [15] found that mastery learning increased student achievement, but that without activities that encouraged participation, students grew bored and thus achievement was lowered. The pedagogical philosophy at CSU-Global Campus is that skills and competencies are just one part of the learning process. Mastery learning activities that are competency-based provide content mastery opportunities and immediate feedback, and account for a nominal portion of each course grade. Students need to become competent in specific skills and topical areas, but then they move on to exercise higher-level skills such as critical-thinking, peer collaboration, synthesis, evaluation and new knowledge construction—which all account for 90 percent or more of the course grade in various projects, assignments and portfolio-quality work. In a global, competitive world, these higher-order skills may give students the edge over their peers who just have "skills," and equip them with the proficiencies to be effective leaders and managers in their field.

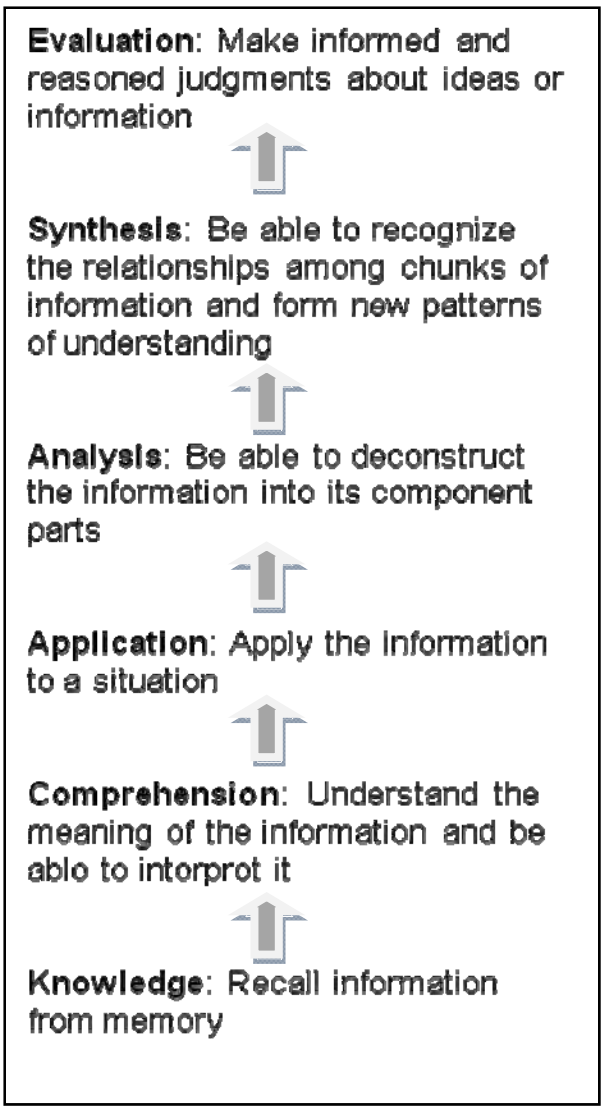

Figure 2: Levels of Learning, Based on Bloom's Taxonomy

Derived from Bloom's taxonomy [14], students learn by:

a) mastering information, such as key concepts, terms and ideas through exposure to the information and recall,
b) progressively grasping the information by practicing learning activities that focus on recall, trial-and-error, and building the vocabulary and comprehension of the information,
c) applying the information to a problem-based situation that can be collaborative,
d) analyzing the problem further by deconstructing the information and reconstructing it into a solution,
e) by applying and analyzing the information, begin to recognize the patterns or relationships between the information and the problem,
f) creating new knowledge and the ability to reason about the information and apply it practically to situations.

Thus, as illustrated in Figure 3, our online learning model utilizes instructivist techniques, such as

mastery learning, to guide students to fully grasp terms/concepts (content), and then employs constructivist techniques to engage students to apply the information in collaborative contexts. The expectation is that all learning activities foster the highest degree of instructor-student, student-content, and student-student interaction, with consideration of the particular discipline and course objectives.

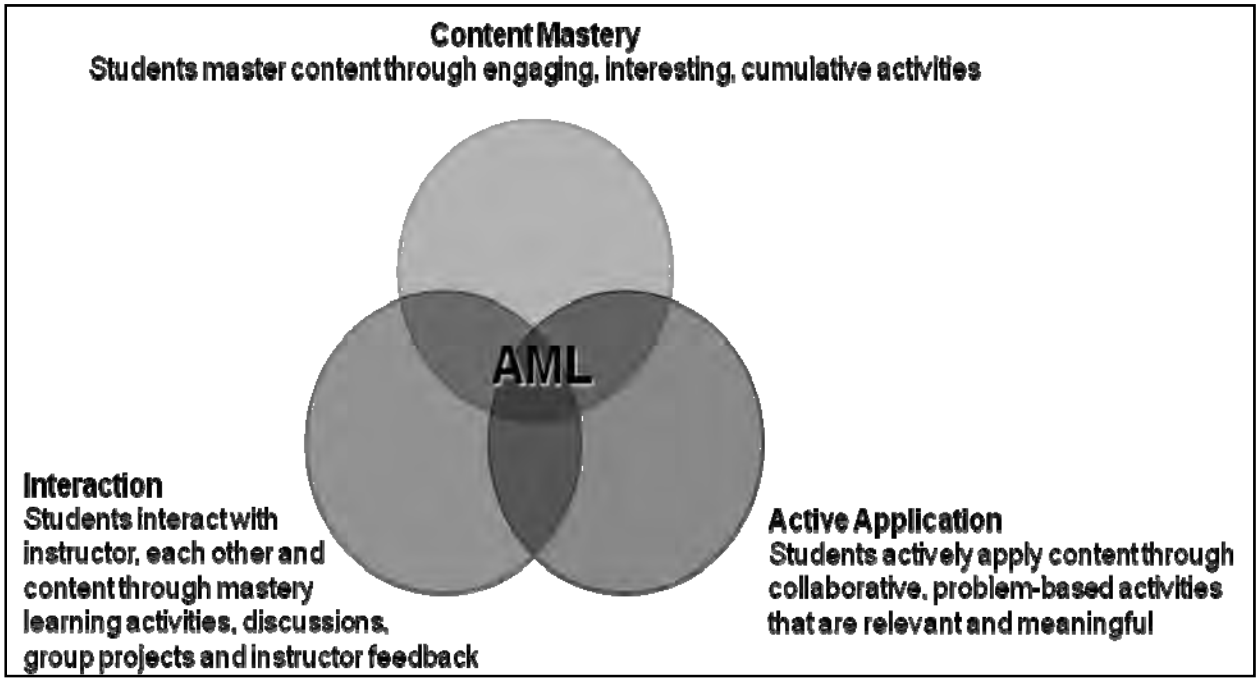

Figure 3: Active Mastery Learning Model

The measurement of quality is a complex and sometimes nebulous task. The Quality Matters program [7] is a research-based program that has received national recognition for their research-based rubric and inter-institutional peer-review processes (www.qualitymatters.org). The Quality Matters rubric is an excellent guide for creating a design standard, or an evaluation system, and can be customized and adapted as needed. We have adapted the rubric to convey the online course design elements to support Active Mastery Learning, and the specific quality criteria within each element.

IV. THE COURSE DEVELOPMENT PROCESS: DEFINING THE TEAM ROLES

While in the early stages of online education, instructors created their own course materials with little instructional design support; however, tales of frustration and lack of support rang in the halls of Academe. Faculty are experts in their discipline, having studied and researched extensively; they cannot be expected to become instructional design experts in the amount of time provided for course development. Designing an online course requires a systemic process that dissects the course learning objectives, presents content, interactivity, and assessment.

One overarching goal of this course development model is to provide ample instructional design, media development, and other resources and support. As Oblinger and Hawkins [16] point out, online courses are no longer content-driven; rather they are complex, technologically-mediated learning experiences that require high-level instructional design, multimedia expertise, and technology skills that few faculty

possess. Courses designed under this model reflect the innovative and creative intent of the faculty content expert, while the instructional design team ensures that each course is Section 508 compliant, accurate, error-free, tested for usability and incorporates an appropriate balance of content mastery activities, interactive activities to foster peer engagement, critical thinking assignments, and high-level synthesis projects**.**

A. Team and Systems Approach to Online Course Development

Moore and Kearsley [17] in describing the systemic model of distance education, compared it to the system of the human body. Each part of the body plays an integral part in how the body works as a whole, some are more important than others, but it takes all parts to support a successful system. The same could be said for the online course development process which is heavily interrelated to online course delivery and is a subsystem of the overall distance education system. Peters [18] recognized early on that the system for distance education was similar to that of the industrialization process because it requires "careful prior planning on a division of labor basis, costly development, and objectivization through media" (12, p. 112). While Peters saw this as a comprehensive system for the production of goods relevant to distance education, the model still applies to the development and scalability of online courses. Peters' [19] theory focuses on the division of labor for the process and concludes the following rationales:

- The development of distance study courses is just as important as the preparatory work taking place prior to the production process.
- The effectiveness of the teaching process is particularly dependent on planning and organization.
- Courses must be formalized and expectations from students standardized.
- The teaching process is largely objectified.
- The functions of academics teaching at a distance have changed considerably vis-a-vis university teachers in conventional teaching.
- Distance study can only be economical with a concentration of the available resources and a centralized administration. (p. 110)

There is a body of recent literature that supports the notion of team-based online course production. Xu and Morris [14] studied team roles and curricular decisions of a course development team, consisting of a project coordinator, a web instructional designer, and four faculty members. They found that despite some issues arising from the collaborative process, such as increased workload and conflicting opinions on course materials, the faculty members considered the experience highly positive.

In our model, we recommend a single faculty member working with the instructional development support team to minimize the potential academic conflict, and also recommend a stronger leadership role for the Instructional Technologist. Hawkes and Coldeway [4] caution against the “lone ranger” approach, where faculty are the graphic artist, the web page designer, the instructional designer, and even the programmer. However, in our model, faculty unequivocally drive the subject matter and work closely with the instructional technologist on pedagogical decisions, and are solidly supported by the instructional development team in matters of technology and programming. An important theme in the literature is that faculty do not resist technology or online course pedagogy when provided with resources and support [5]. The support investment is well worth it to create efficient processes where all team members are utilizing their specific talents and expertise, and where all team members feel supported.

We suggest the following roles for a team approach to online course production:

Team Member	Role
Course Developer	• Senior subject matter expert/lead faculty member • Ensures that the development is in line with the curricular goals and ensures academic quality exists
Course Development Team Member	• Also a subject matter expert • One or more may participate, depending upon scope of project, or other special circumstances • Works collaboratively with the lead Faculty developer to select and/or design course materials, etc.
Instructional Technologist	• Acts as a pedagogical and design consultant on up to 10 concurrent development projects • Employs an instructional design model, such as ADDIE [19] • Acts as a project manager for each development project • Assists the team in selecting course materials and learning objects that support online pedagogy • Ensures that the course design is adhering to the quality vision and design standard
Course Technicians (Techs)	• Acts as technical support on several concurrent development projects • Provide programming support and assistance with technical aspects of the course; for example, load course content, design course banner and graphics, work on look and feel of course, find or create learning objects, load quiz and exam questions into the CMS, help developers record audio/video, help developers ensure that the technologies are appropriate for the course, include text scripts for ADA compliance, test the course links, proofread, etc.
Librarian / Copyright Clearance Coordinator	• Provided through library services for review of courses for TEACH Act compliance and to handle copyright clearance, reserve readings, etc.

In the organizational model being established at Colorado State University-Global Campus, the Instructional Development Unit houses the above team members, and also includes supplementary roles, including a Director of Faculty Development and Support, a Director of Institutional Effectiveness and Quality Assurance, Program Chairs, and Core Faculty. Together, the Instructional Development team supports the entire online course development model and integrates faculty into the organization as key players and decision makers, not just clients.

1. Who Does What?

The table below illustrates the content elements of an online course, derived from Active Mastery

Learning and the Quality Matters rubric [7], and denotes the team member with primary responsibility for each online course element.

Course Element	**Standards**	**Roles**	**Examples**
Course Overview and Introduction / Student Orientation	• Introduction to the course structure, style, learning experience, technology requirements • Explanation of support resources • Explanation of course policies • Navigational instructions • Explanation of general expectations • Instructor introduction	• Course Developer and Instructional Technologist • Instructional Technologist to provide any static institutional information (such as support resources, contact information, institutional policies, etc.)	• Welcome video • “Icebreaker” activities • Text announcement • Any"housekeeping items" covered
Syllabus	• Detailed syllabus document, with timelines, course policies, unit schedules, and other specification included in a template provided to faculty	• Instructional Technologist to provide template • Course Developer modifies course-specific information	
Course Curriculum/ Objectives and Learning Outcomes	• Course topics are clearly explicated • Course level learning goals and objectives clearly stated and address content mastery, critical thinking skills, and core learning skills • Course outcomes are clear and measurable • Each module and unit includes this element	• Course Developer • Instructional Technologist	• List of clear objectives and learning outcomes • Identification of knowledge needed in subject area to gain expertise
Course Content	• The course materials support the learning goals and objectives • The course materials appeal to diverse learning styles and are appropriate to the online learning environment • The course materials are well-organized into a logical flow, and easily accessible • All course materials are appropriately cited and copyright compliant	• Course Developer • Instructional Technologist and Course Technician (to help select types and formats of content) • Librarian	• Textbook readings, audio clips, video clips, lecture notes, podcasts • Slideshows • Worksheets for lecture support
Mastery	• Activities are included that	• Course Developer	• Flash-based learning

Activities	allow students to practice applying the informational concepts presented in the course content • Activities are non-threatening, and are engaging, interesting, and even entertaining • Activities allow for multiple attempts • Activities are based on course materials that are tied directly to learning objectives • Activities provide specific, immediate feedback and students are able to track their progress	• Course Technician (to help select types and formats of content, or create/load activities) • Librarian (when necessary, to clear copyright for learning objects)	exercises such as games like Jeopardy, crossword puzzles, and digital flashcards • Online quizzes • Simulations
Interaction and Collaboration	• Interactive activities promote interaction among student, and with instructor • Interactive activities are tied directly to learning objectives • Interactive activities engage students with the application of the information in a meaningful and interactive way in order that they construct new knowledge in a collaborative environment (constructivism) • Rubrics are provided that specify the interaction criteria for students • The design of the activities prompts the instructor to be present, active, and engaged with the students	• Course Developer • Instructional Technologist (to help select activities and discussions that create engagement, interaction, reflection)	• Discussions • Synchronous interactions (Chat, Whiteboard, etc.) • Group activities such as team site building
Assessment and Measurement	• The types of assessments selected are based on course materials that are tied directly to the stated learning objectives • There are multiple types of assessments and they are weighted such that students have multiple paths to success • Students receive	• Course Developer • Instructional Technologist	• Exams • Written assignments • Portfolios • Assessment should never be exams only

	personalized feedback from the instructor • For written assessments, rubrics are provided that clearly specify success metrics • Authentic assessment techniques are incorporated		
Course Technology	• Tools and media are selected to support the learning goals and objectives • Technology is easily accessible and current • Technology encourages students to be active learners • Technology selection poses no undue financial burden on students (unless absolutely necessary to the course)	• Course Technician	• Wikis • Blogs • Journals • Videoconferencing
Accessibility	• Course is ADA compliant	• Course Technician	• Checklist/review

Of course, the above course element table can be expanded to include more or less detail, and should be based on the institutional model for online course quality. However, the objective is to have a "specifications" sheet, and preferably a model online "demo" course to which the instructional development team can benchmark their progress.

The question of "standard" or "canned courses" should be addressed here. There are good arguments for and against standardized courses. The scope and depth of standardization is an institutional question, and must be addressed in the context of the course distribution model. With higher volume of enrollments, it can be expected that an institution will have multiple course sections being taught by multiple full time and adjunct instructors. In addition, students will be moving quickly and continuously through courses in the program. It is important to minimize student confusion over language and navigation, as well as be able to preserve the curricular integrity of courses so that course sequences, particularly those involving prerequisites, are carefully managed.

The argument against standardization is typically one of academic freedom, and the negative effects of standardization on creativity and innovation. We would argue that there is a middle point, and achieving it lies within the key involvement of faculty in the online course production and delivery processes. As described earlier, the model at Colorado State University-Global Campus integrates faculty within the Instructional Development organization as key players and decision makers. We recommend utilizing core faculty as lead faculty in the production and delivery of sets of related courses, and empowering them to update and modify their assigned courses, thereby keeping them relevant, "fresh," and reflective of new information and research, and new pedagogical techniques.

V. ORGANIZING THE WORKFLOW AND ESTABLISHING DEADLINES

We propose a fourteen-week phased approach to online course production, as shown in Figure 4.Within each phase occurs various steps and processes, of which we have provided the crucial ones. The information and process steps we have provided must be adapted to the particular institution's framework and policy guidelines, and other steps note mentioned here will emerge as the entire process evolves. This, however, provides a framework for the individualized process to grow into.

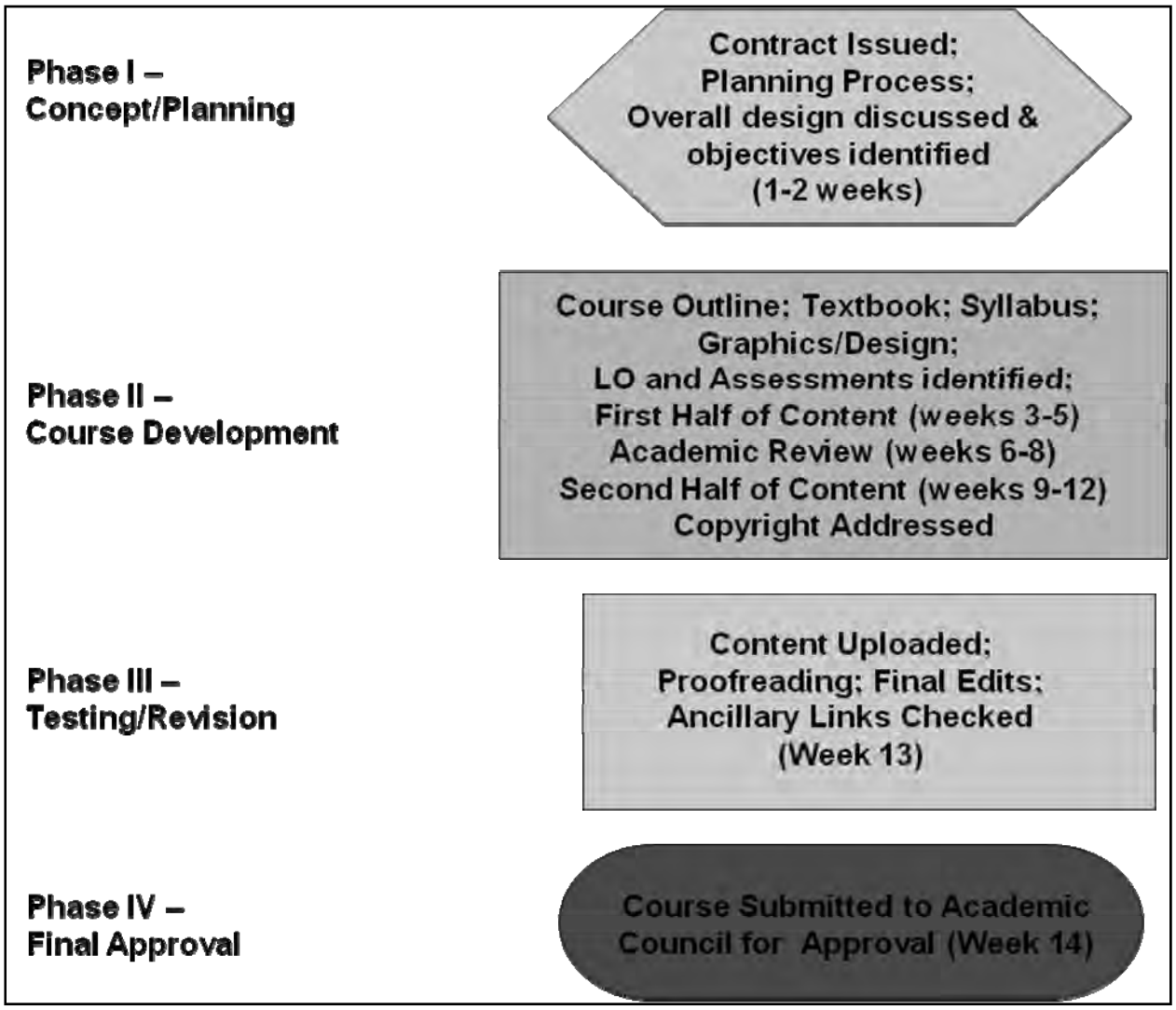

Figure 4: Phases of the Online Course Production Process

A. Phase I – Week 0

To begin the course development process, a contract is issued and signed by the content experts at an initial orientation meeting. This contract defines expectations for both the subject matter expert(s) and the course development team along with the commitment to follow the 14 week development process as well as provides information regarding payment for the course. This contract is important, as it also defines the institutional policies and any intellectual property issues in the development process. Intellectual property

is a complex issue, and the institutional general counsel can and should provide input on the development of the legal policy.

Next, the dates for meetings and are established along with a discussion on the resources available for course development such as graphical design, learning object development and copyright support. The core team (Instructional Technologist, Course Technician, and Copyright Librarian) is then introduced to the Course Developer and their roles defined. In our model, the primary "manager" of the workflow process is the Instructional Technologist, and the "co-manager" is the Course Developer. Each needs to be empowered to execute their roles effectively and so "buy-in" of the roles is critical.

At this stage, the team should also make decisions about their communication processes, expectations, and formats. Many Course Developers will be remote, and the group must consider the best technologies for facilitating the work of the team. The new courseshell will then be created in the courseware management system and the subject matter expert(s) will be provided access (ids and passwords). At this point, the initial course syllabus and the assessments already in place will be reviewed for online conversion and the textbook and its resources are examined (for example, does the textbook provide specific graphics that could be used in the course design?).

A course planning document should be provided which is merely a springboard for the subject matter expert to sketch out the course topics and assessments. Institutional policies such as a statement that requires student online participation will be provided for syllabus development and copyright permission forms provided to request usage if guided by the copyright librarian as well as a Teach Act checklist that guides online usage of digital materials. The planning document should be derived from the course design standard, and parallel the language, style, and navigation of the expected final course product.

An excellent resource for this phase is a course developer orientation and a handbook to guide the process. This documentation will serve as reference material for the entire development team. There are numerous excellent examples available freely on the web from various institutions. We also recommend having a "model" course that the faculty can use as a benchmark and emulate in the design and development processes.

In Weeks 1 and 2, the real work begins. Planning commences with discussions of the conceptualization, graphical design, and course planning. After reviewing the learning objectives, the team will discuss any problem areas they see with the content development such as online lab assignments. The development team will then examine the course template for any necessary modifications and then assessment strategy will be reviewed. In this phase, we also recommend involving the Copyright Librarian to begin working with the Course Developer on consideration of materials, and the identification of any potential copyright issues with regard to the initial thinking about the course materials.

Assessment for online courses should never be based upon exams only. In the Active Mastery Learning model, we emphasize multiple paths to success, and active learning techniques. Students will submit several types of assessments which in turn, provide an overall footprint of their work. Online assessment should include online discussions and may also include journaling, case studies, quizzes and exams, just to name a few. The course should incorporate a strategy for building an active community; therefore, an introductory icebreaker exercise may be discussed with different examples provided.

B. Phase II – Weeks 3–5

In Phase 2 and by the third week, the team should create the first prototype unit, which includes placeholders for images, interactions, learning games, interactive media objects, etc. This prototype lesson should be checked against the learning model, in this case Active Mastery Learning, and the entire team should agree on the design, the pedagogy, the navigation, the look and feel, and the connection of the unit to the learning goals and objectives.

In this phase, the first draft of syllabus and course schedule should also be submitted by the Course Developer, and should contain the following elements: textbook, supplemental readings list, policies and resources (per syllabus template which will be provided), modularized 8-week course outline with readings, topics, learning goals and objectives, assignment/assessment plan, and discussion questions for each unit. The Syllabus template will also include "static" content (such as contact information, student resources, institutional policies, etc.), and this content should be standardized and maintained by the Instructional Development Unit staff.

Once the course unit prototype and syllabus delineating the weekly goals, objectives and content, is approved, weeks 3-5 are where development should gain momentum. An important part of the process is having milestones and frequently checking progress. Thus, we recommend that the first half of the course content is provided to the team (four complete modules) that contains lecture materials, learning objectives and assessment items. The Copyright Librarian should be involved in this review as well, in order to identify and address and potential copyright issues. This first half of the course should also be submitted for academic review, to ensure that the academic integrity of the curriculum is supported by the course design, pedagogical choices, and technology selection.

C. Phase II – Weeks 6–8

Review of the first half of the course content may yield feedback to the development team and adjustments warranted. The Course Developer is consulted for content revisions, while concurrently he or she is working on the last half of the course content to be submitted. This time in the phase allows for catch-up if necessary.

In week nine, the Course Developer will begin submitting content for the rest of the course materials. The Course Technician will make any necessary edits on the first half of the course after review and also work on developing learning objects, loading exams and quizzes, and creating placeholders for the content. By week twelve, all content should be loaded into the course template.

D. Phase III – Weeks 12–13

Weeks twelve and thirteen are spent reviewing the second half of the course modules as well as proofreading, testing and revising navigation, electronic activities, etc. The final proofreading and editing should be completed and all hyperlinks and attachments are checked and tested.

E. Phase IV – Week 14

The final week of the course development phase is allocated for final approvals from the Course Developer, Instructional Technologist, and Course Technician. The Copyright Librarian should also review for any last minute copyright requests. The course is then submitted to the institution's academic council for final approval, if necessary. A date is determined for deployment into the course schedule. A

post deployment meeting is scheduled for a week or two after the course has been taught. Careful notes should be taken by the instructor throughout the first semester the course is taught.

VI. COURSE MAINTENANCE

Once courses are entered into a "repository" for the institution, it is important to establish processes and policies to maintain the currency of the courses, as well as update or adjust the course based on feedback from students or faculty teaching the course. Shortly after the course is taught for the first time, the team will review notes kept by the instructor(s) as it was taught. The following items should be discussed and revisions suggested:

- What worked well?
- What were the problem areas?
- Suggestions for improvement?
- Student Feedback?

Revisions will then be made before the next time the course is deployed. A follow-up meeting should occur to discuss revisions after the course is taught again. At this point, the course should be cycled into a normal course update process as determined by the institution which could be 2–3 years or sooner if necessary.

Much of the course maintenance will be driven by the edition cycles of textbook publishers, if traditional textbooks are used. And, Course Developers who update courses will expect a payment for the work. This can become chaotic and costly as course and enrollment volume increases.

There are many possible models for maintenance. Again, we refer to the model of integrating faculty into the organization. In the Core Faculty model, salaried instructors are responsible for selected groups of courses, and they manage the revision process. However, in institutions that primarily utilize adjunct faculty or have shared governance structures where faculty governance and evaluation are dispersed among multiple academic units, the Core Faculty model may not be feasible. However, an appropriate model and process must be established.

VII. CONCLUSIONS

As Porter [20] states, "An effective curriculum must be well structured, innovative, filled with usable and appropriate course content, and interesting to a variety of people who take each course and work through a series of classes" (p. 75).

The model presented in this paper is one way of achieving such an effective curriculum. With minor adjustments and adaptations, this model should help institutions create a process for organizing online course development into an efficient, coherent, and focused practice. As we continue to learn from our peers, research online learning, and keep learning from our mistakes our model should evolve. This model is currently being implemented at CSU-Global Campus, and formalized research to evaluate the model based on faculty satisfaction, efficiency, quality of design, and student learning outcomes is planned for 2008–2009. Preliminarily, the feedback has been positive and we are looking forward to reporting on the efficacy of the model and practical lessons learned in subsequent reports.

Online education has forever transformed higher education, and we are learning that quality is really about flexibility and the ability to adapt to the changing demands of learners, the new promises of technology, and the new competitive landscape of higher education. If higher education is to remain competitive, we must refocus and redesign our paradigms, as well as design business processes that integrate with quality assurance models.

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IX. ABOUT THE AUTHORS

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STUDENT EXPERIENCES OF USING WEBLOGS: AN EXPLORATORY STUDY

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ABSTRACT

Recently, attempts have been made to use Weblogs and other personal webpublishing technologies to support individual and social reflection in higher education. Weblogs can be highly individual and reflective in nature, and students' experiences and perceptions of the technology and practice are of primary importance in furthering educational use. In this phenomenological study 8 participants who maintained Weblogs in a graduate course were interviewed. Initial data analysis indicates that participants found Weblogs helpful for learning, reflecting, and building a sense of community. However, participants expressed concerns over the lack of structure for Weblog usage and the public nature of the reflective process. Implications for future practical and research applications of Weblogs are presented.

KEYWORDS

Weblog, Blog, Reflection

I. INTRODUCTION

Personal Webpublishing systems, of which Weblogs are one popular instantiation, are increasingly used in social, political, educational, and business settings. Reports on usage of Weblogs (or blogs) and practices of writing on Weblogs (or blogging) abound in both popular and academic literature. Estimates of the number of extant Weblogs range between six and eight million in the U.S. alone [1]. The large majority of Weblogs are personal and informal—that is, the content is written by an individual and represents a personal view. Although empirical research is still scarce, Weblogs are increasingly being integrated into education, especially into higher education to support student speech and to inculcate higher order thinking [2] and also to introduce students to academic thinking and discourse [3].

In higher education, Weblogs have been implemented to learn about journalism and current events [4], and to support self-directed learning [5], analytical thinking [6], and self-organized and reflective thinking [7]. Practical evidence indicates that students engage sporadically in the writing of the Weblogs, even though most indicate an awareness of benefits of blogging [e.g. 4, 6]. In our research, we implemented Weblogs to foster student reflection and to support students in meaning-making and articulation about the process of instructional design. However, as with other studies, our investigations indicated that students found it difficult to engage consistently in reflective writing on the Weblogs. For example, some students wrote sporadically, while others focused on trivial, non-reflective aspects of the design process.

In this paper, we examine student experiences of using Weblogs for reflection; specifically, we focus on identifying experiences that aided or hindered students' practice of reflecting on the Weblogs. We

describe data collection and analysis, and present findings that emerged from the data. We conclude by discussing these findings and identifying their implications for further research and practice.

II. USING WEBLOGS TO ENGAGE STUDENTS IN REFLECTION

Personal Webpublishing has emerged as a popular technology-based instantiation of journaling in the past few years. Weblogs, one of the most popular forms of personal Webpublishing, allow individuals to publish their thoughts, commentaries, and reflections in the form of individual posts of varying lengths on a Web page. Since the software is server-based, a Weblogger (or blogger) can log in from any Internet-enabled computer and add new posts, thus supporting the possibility of spontaneous recording of thoughts and experiences. Weblogs offer two advantages for reflection: one, they support student ability to record and revisit experience, which is an important part of reflective learning [8], and two, Weblogs offer the potential for abstraction—by writing posts, students are perforce engaged in articulating thoughts and feelings, which can lead students to reflect on their understanding of content and own learning [9, 10, 11].

Reflective journaling on a Weblog is different from writing on online bulletin boards or chats, even though each forum allows individual publishing of thoughts and arguments. Writing on discussion boards and chat rooms is essentially a dialogue between multiple individuals; that is, the posts are interwoven and build on each other. Conversational triggers are generated by different individuals and most often the responses are posted in reaction to specific conversational gambits. Weblogs, on the other hand, represent an individualized space that is more supportive of a dialogue with self than others. Although empirical research on Weblog use in higher education is relatively scarce, informal accounts from practitioners and researchers indicate that Weblogs can be an important individual conversational learning space [e.g., 12]. Weblogs also allow for the integration of a wider range of information from other online sources [13], and encourage individual critique, commentary, and evaluation of varied information sources since quality of writing and content is indicative of higher numbers of readers [14]. Weblogs can offer significant advantages because they support consistent, long-term individual monologues, and simultaneously allow commentary and evaluation by others [14].

III. WEBLOG USE IN HIGHER EDUCATION

Informal accounts of Weblog use in educational settings abound, but published research reports on this topic are infrequent. Some empirical research exists on the role of discourse and communication in Weblog communities [see for example, 15], where the focus is on naturalistic reports of Weblogging practices that emerge within the informal community. In formal education, however, empirical reports on students' use of blogs are rare. Informal reports of blogging indicate that student use of and writing on blogs is affected by multiple influences; however, no systematic effort has been made to describe the sources of influence and student reactions to these influences.

For example, Bartlett-Bragg [5] summarizes informal student discussions on the use of Weblogs: Students found Weblogs useful for freedom of commenting, for publishing unconnected pieces of knowledge that were personally meaningful, and as a space to record learning so that it could be revisited. Hernàndez-Ramos [16] used Weblogs in a teacher preparation course and based on student writing on the blogs, he identified that a majority of the students found the experience rewarding and different. He also identified that some students had passionately adopted the blogging practice, while other students were reluctant to engage in the process. However, Hernàndez-Ramos [16] did not present further evidence about why students reacted positively or negatively to Weblog usage. Williams and Jacobs [17] surveyed graduate business school students who were encouraged to use blogs over a six week period in one of their courses. Only half the students chose to blog; their opinions were collected using a Likert-scale type

survey. Most students felt that blogs helped their learning and cited discussion and time to reflect on their blogs as key aspects in blogging. Students also felt that blogs allowed meaningful exchanges of information between peers. However, Williams and Jacob's [17] survey did not provide any specific or detailed information on what prompted students to blog or what factors supported their engagement with this medium. The points awarded to blog participants were so few that, in fact, students who did not participate in the blogging cited low points as a lack of incentive. However, additional details on why some students chose to blog despite low-value of external rewards could have provided some more information on the influences on student blogging.

The examples cited above are among the few studies that cite empirical or anecdotal data in support of student perceptions of Weblogs, however, none of them describes in detail the influences that affect student usage of Weblogs for reflection in formal settings. Since reflection combines affective and cognitive attitudes and skills, an understanding of students' experiences with and their attitudes towards this technology and practice could potentially offer guidelines for using Weblogs to enrich students' learning experiences. Thus, our focus for this study was: how do graduate students engaged in course-specific web logging activities describe their experiences of reflecting on the Weblogs?

IV. RESEARCH CONTEXT AND METHODS

Field research methods were employed to explore the experiences of graduate students in their Weblogging activities. A phenomenological approach was selected as the most useful research method in this context [18].

Participant	**Age**	**Study Major**	**Previous Blogging Experience**	**# of Posts**	**Content of Weblogs**
Scott	40	Adult education	No	13	• comments on text • comments on project content
Jack	34	Adult education	Yes	14	• comments on text and other web-based articles • reflections on designing and designers • reflections on project process
Lisa	34	Instructional systems	No	13	• comments on text and other web-based articles • reflections on design and learning theories • reflections on own learning and activity
Tom	27	Instructional systems	No	14	• comments on text and other web-based articles • reflections on role of design and designers • comments on the process of blogging
Betty	32	Curriculum and Instruction	No	7	• reflections on prior design experiences

					• reflections on instructional design and teaching • comments and resources related to the project
Jane	32	Workforce education	No	8	• comments on text and other web-based articles • reflections on design and being a designer • comments on project progress and processes
Eric	30	Instructional systems	No	1	• general thoughts about design
Cathy	24	Instructional systems	No	9	• comments on text and other web-based articles • reflections on design, technology, and role as designer

Table 1: Participants Demographic Information

Study participants were 8 doctoral students——four males and four females between 24 and 40 years old——who enrolled in a graduate level instructional design course offered at a large northeastern university (see Table 1 for participant profiles). The study participants maintained Weblogs for one academic semester as part of the graduate course requirement. Each student was provided an individual Weblog and the capability of posting any number of comments per day and the ability to upload pictures and files, if needed. The instructor maintained a main course Weblog providing administrative information and additional content and links as needed. The instructor also referenced posts made on individual student Weblogs on the main course log. All course weblogs (including the instructor's) were cross-indexed on each individual's Weblog page so that students could easily view others' Weblogs by clicking on the links. Although students were encouraged to comment on other student Weblogs, the instructor did not provide any direct intervention to encourage the discourse, except to reference different student Weblogs on the main course log. On average, each student posted at least one comment per week on the individual Weblog. Criterion sampling [19] was used to select class participants who had maintained Weblogs for at least one semester. In addition, the participants were willing to participate in the study and describe their experiences and thoughts in great detail [20].

V. DATA COLLECTION AND ANALYSIS

An interview guide [21], which combines pre-determined and spontaneously generated questions, was used to conduct an hour-long interview with each participant. Interview questions revolved around the following main themes: students' experiences and feelings about using Weblogs, their approach to reflecting on the Weblogs, and their perceptions of utility in their learning. Table 2 lists the pre-determined questions used to probe student experiences of Weblog usage. These standard questions were augmented with additional open-ended questions to probe a participant's specific thoughts and responses.

1. **You kept Weblogs for a whole semester. Could you tell me what you did, what you didn't do, and how you felt?**
    a. Can you talk specifically about when you wrote on the weblog and

why?

b. What things encouraged you to write?
c. What discouraged you from writing?
d. What types of writing did you do on the Weblog?
e. How did you develop an idea of what and how to write on the Weblog?

2. How did the experience of Weblogging affect you?

a. What feelings were generated by the experience? What instances made you feel that way?
b. What thoughts stood out for you?

3. Did you develop a style while using the Weblog?

How did that style emerge?

4. How often did you visit other classmates' weblogs? Why did you visit them?

5. How often did you visit other Weblogs outside of the course? Why did you visit them?

6. How did Weblogs affect your learning in the course?

Table 2: Interview questions for probing student feelings about Weblogging

All interviews were transcribed and transcribed data were analyzed using N-Vivo. Free codes and axial codes were generated through analyses of the interview transcripts. Data analyses comprised preliminary grouping, also called "horizonalization," [20], thematic labeling, and finally, developing a textual-structural description. Table 3 presents a sample of horizonalization and thematic coding. The aim was to develop a composite description of experiences of participants and identify different influences on perceptions and on the use of Weblogs and their contribution to students' reflective thinking and learning. After the primary data analysis, individual interview summaries were sent to participants to confirm accuracy of interpretation. Additional data triangulation was achieved through peer review of codes.

Horizonalization	Thematic labeling			
It (weblog) primarily helped me to think of things in a different light, in a different direction. … So if somebody else likes to contribute their experience, I thought that enriched the course, maybe challenged some views. I thought the answers have to be this way. But then somebody else does some other way and they get better results. So it let me consider other alternatives. (Jack, para 74–75)	Others' view-different light	Different points of view	Blogs helps learning and thinking	Positive feelings about weblogs
(The course log provided additional resources and they are helpful because). Since this was an introduction course, there was so much to be looked at, and assimilated. Having alternative perspectives was very helpful. I think it is usually helpful. Different explanation, or different point of view, a better rounded experience of it. (Lisa, para 48–51)	Course log-offer different perspective			
Because when you think it's ok, but you forget what you think after a while. If you keep, archive what you've written down, it's better. Because if you come back for your thoughts, after a while you forgot what your thoughts were, what you write about. It's good to come back and read and know how much you grow. You can actually see yourself grow… and you can actually see how different you are… It's good for tracking. (Cathy, para 102)	Good for tracking changes	Chart changes for reflection		
Weblogs can provide a discourse for reflection. …. It sort of lays out for you a roadmap of your development in an area and in a concept, which is very nice. (Scott, para 157)	Provide discourse for reflection			
… (the instructor) connects other people together. She summarized what other people talked about. … It brings a feeling that we now know all. We all belong to something, we can interact with each other. (Cathy, para 68)	Course log-bring everybody together	Sense of community		

Table 3: Examples of Horizonalization and Thematic Labeling

VI. FINDINGS AND THEMES

Data analysis at a more categorical level is still ongoing, but here we present some of the initial themes that have emerged through analysis. Overall, student experiences can be grouped as positive and negative. Most students categorized their Weblogging experiences as being positive because they felt that Weblogging helped their learning and thinking and offered a space outside of the class where they could "meet," creating a sense of community. Also, being graduate students in instructional design, participants were motivated to explore a new type of technology and to understand and tap its potential for their own future instructional design uses. Negative experiences were related to lack of privacy and lack of structure on blogging procedures, which in turn resulted in frustration and decreased motivation to engage in the activity. Table 4 presents an overview of the themes corresponding to positive and negative experiences about Weblog usage.

Positive experiences
1. Weblogging helped thinking and learning a. Providing access to different viewpoints b. Providing space for organization and collection c. Triggering careful examination of content
2. Weblogging provided a sense of community
Negative experiences
1. Uncertainty about correct usage of Weblog
2. Differences in familiarity and experience with content
3. Concerns about privacy

Table 4: Themes Related to Participant Perceptions of Weblogs

A. Weblogging Helped Thinking and Learning

The first theme in the positive experiences of Weblogging is related to participants' perceptions of the utility of Weblogs in aiding thinking and learning. Primarily, participants perceived that Weblogs supported their learning by providing different viewpoints, by providing a space where changes in thinking could be charted, and by requiring them to think more critically about reading materials and resources.

B. Providing Access to Different Viewpoints

Obtaining different viewpoints was identified as important in supporting participant thinking and learning. Participants suggested that the instructor's and other students' Weblogs were useful in providing diverse perspectives and information beyond the class content. The various Weblogs also provided ways of connecting course content to individual experiences. The diverse perspectives were deemed helpful in

providing a holistic, in-depth view of the content, as is evidenced by Scott's description.

> …have others to offer their thoughts and opinions … and offer another point of view, something else from another point of view. And now you are looking at the whole spectrum, you are not looking at one part of a circle. In fact, you are looking at many arcs in hopes of completing a circle of knowledge toward a particular subject…. You may find further thoughts deeper than your own thoughts through reading what others have to say, or listening to others' ideas and reflections. And that furthers what's in your mind. And it deepens, broadens your understanding of the material. And it makes your ideas applicable for some research in the future, or opens up avenues you have never thought prior to that. So it gives you ideas, spurs different thoughts in your mind and deepens your understanding.

Two participants commented on the diversity of perspectives as helpful for challenging and augmenting their thinking. Jack, for example, referred to the utility of other views in enriching and presenting alternatives to his thinking. He said that others' experiences challenged some views where he "thought the answers have to be this way." Lisa commented on the utility of other perspectives in allowing her to glimpse a holistic picture of the topic: "I think it is usually helpful to have a different explanation, or different point of view, a better rounded experience of it."

C. Providing Space for Organization and Collection

Participants also perceived that Weblogs helped their thinking by providing space for organizing and synthesizing thinking as part of their learning. Scott and Jack appreciated the provision of a structured space to archive different pieces of information and thus gain a composite view of this information. Scott appreciated the utility of the medium to "organize your thoughts, see how well you do understand the material." Jack similarly commented:

> …as a part of my own study, I gain from so many different places. Like, I have to read a chapter, an article, and another article. They are isolated in their presentation, but the weblog kind of helps me to read them into something that makes sense. You take learning, bring it into your own context and structure it to make more sense. The process I was going through I thought was rewarding. I was able to construct these blocks into new blocks of my own when I came into the class with my own mental model of how the pieces work together, instead of just pieces.

Jane and Tom presented a slightly different perspective, commenting on the utility of Weblog writing as a mechanism to organize and articulate their thinking. Jane commented that writing was "a process that makes you think in an ordered way" and she found the space helpful in summarizing her thoughts. Tom perceived the Weblogs as space that engaged him in tracking his thoughts and "to think and articulate ideas."

Information organization and archiving on the Weblogs was also perceived by participants as being useful in "charting" changes in thinking. As participants revisited their Weblogs, they perceived changes and growth in their writing and thinking, and that helped them to reflect on their learning. Scott perceived that the Weblog allowed him to view the integration between old and new knowledge, commenting, "it sort of lays out for you a roadmap of your development in an area…you can chart your thoughts from day one to the end of semester to see how your thoughts developed." Cathy felt that the Weblog reflections allowed her to archive and track thoughts, and see "how different" she was and how she had progressed in her thinking.

Besides allowing him to compare a progression of thoughts, Tom also perceived that Weblogs increased the pace of his thinking and change, commenting that without a concrete historical perspective, he may have found it difficult to reflect on his learning. He felt that Weblogs helped him to "articulate …and compare ideas" by providing "a history of …thoughts."

D. Triggering Careful Examination of Content

Weblog publishing also encouraged participants to focus on their reading materials. The requirement to write on Weblogs "pushed [them] into deep thinking" about the content, as indicated by Jack.

> For me as a student, it was an opportunity to do something with the material aside from just reading it. So it was educational experience just writing itself… because it keeps me actively interested in what I am reading instead of sometimes when you read, you drift off, you lose your attention. But it keeps my attention… Aside from just giving me the opportunities to express them, it helps me to focus, I think. It helps me with the synthesis step, so things make a little more sense… it gets me more interested in the subject matter. I think it made me feel more confident too because I kind of thought it over, you know. I already considered the content and put it together in a new way that makes sense to me. (Jack)

Participants also identified the requirement to post as a trigger for engaging in in-depth analysis of reading materials and content. Lisa explained that writing for the Weblog made her more prone to evaluate content and said that she tended to "look more critically … I would want to know something more where it [content] didn't fit my experiences." Cathy admitted to using a more procedural strategy for recording thoughts consistently, using the Weblog as a place to store her thoughts as she read content.

The previous three sections referred to positive experiences of blogging in helping thinking and learning. Another positive experience was related to the sense of community engendered by Weblogs. Participants felt that the sense of closeness contributed positively to the experience; however, they did not relate it directly to their learning. In the next section, we elaborate on this perception.

E. Weblogging Provided a Sense of Community

Participants perceived that Weblogs created a sense of community and extended discussion within and outside of the class. For some participants, such as Scott and Lisa, the involvement with other students contributed to a sense of togetherness, which seemed important in supporting their learning. Scott commented on the importance of shared learning experiences in stimulating mutual growth among class participants.

> My feeling is that you are part of a community. That was nice. You feel you are part of a group, part of an effort. You are actually included something. You don't feel you are alone, because even though you are new to the field, you are still struggling. And it is that feeling of cooperate that we are all struggling to understand this together … At least it opened up that avenue that I wasn't going through, trying to understand it alone… being a part of learning community helps to stimulate and sustain that growth. And being able to share with others to me is the importance of a learning community, to help stimulate my growth and help to stimulate someone else. And we can sustain ourselves over the course of, in this case, a semester, but you would hope that that information becomes part of you, part of your repertoire, such that it is the basis on which you do further decisions. (Scott)

Cathy commented on the Weblog's utility for accessing other people's views and engendering a sense of familiarity for others. She felt that the instructor's log, by summarizing different logs, gave a "feeling that we now know all. We all belong to something, something we can interact with." She specifically admitted liking "the sharing, the community, the interaction with other people" that emerged from Weblog interactions.

Three participants commented on the ability of Weblogs to extend discussion and generate conversations. Jane and Lisa perceived the Weblog as a space to invite additional conversation. Lisa commented that reading others' Weblog reflections would trigger face-to-face conversations, either to clarify or counter a prior post. She felt that this mechanism opened "a door for additional communication face to face." Jane similarly liked the additional interaction generated by Weblogs, especially when she posted a "very interesting, very original or creative idea." This type of posting led to the initiation of conversations by interested readers, and Jane felt that this was "good."

VII. POSITIVE EXPERIENCES AND PERCEPTIONS RELATED TO WEBLOGGING

The first positive experience of blogging was related to the availability of different perspectives on content. Reflection can be construed both as a solitary and social activity [22]. Some theorists envision reflection as an individual process but conceive of reflective practice in a social plane, where individual artifacts, thoughts, and reflections are shared and commented on in a public space [23]. The combination of individual reflection and access to the group's reflections seemed to challenge participants' thinking and interests. This type of dialogic interaction with artifacts is key to reflective and critical thinking [24, 25], which encourages careful examination of one's thinking in the context of competing (or consensual) views.

Weblogging seemed to be very important in providing space for students to organize and archive content-focused, reflective commentaries. Individual Weblogs allowed students to record their thoughts and feelings, which were then revisited as needed. This iterative sequence of recording, followed by reflection on the feelings is central to the conception of reflection suggested by [8]. In this case, Weblogs seemed to offer a benefit similar to those offered by personal diaries—the ability to serve as a record for thoughts, which is available for re-reading [see for example, 26]. Like diaries, Weblogs also were able to support student self-expression, which as research indicates, is generally appreciated by students [27, 28]. Educators in math and science have propounded the utility of an explicit space and semiotic modality for reflection [see for example, 29], and the inclusion of specific interactions that support individual and social reflection.

Another positive perception of Weblogs was related to the utility of writing on the Weblogs and its contribution to reflection. The participants commented that they valued the ability to use writing as a method to think deeply and to articulate ideas. Sá [30], for example, suggests that writing is useful to represent thinking as well as to develop skills for thinking and articulating thoughts. Keys [31] identifies three types of writing in writing to learn—expressive, transactional, and poetic. Expressive writing is informal, personal, and without consideration for others' judgments, thus allowing the writer to make connections between prior and new knowledge. Transactional writing, on the other hand, is more communicative and focuses on writing to an audience. It appeared that students generally regarded the Weblogs as transactional rather than as an expressive writing space, as is apparent in Scott's quote:

> I was writing to myself. But in the back of my mind, I knew almost anybody can see this. … what was there [on the Weblog] had already been considered, it wasn't initial pure thoughts. It was items which I had already addressed and once they were dressed up, made more sense, they were entered at that point of time.

Data also indicate that participants perceived writing as a way to learn rather than purely as an end product of learning, much as established in Jasper's [11] research with nursing students. According to some participants, the act of writing triggered careful examination of content. In the context of writing diaries for qualitative research, Sá [30] identifies the importance of extracting deeply meaningful experiences or instances to ensure that the sampling is not superficial or meaningless in the context of the overall analysis. In a similar manner, it may be construed that the self-reported perceptions of participants' deeper engagement were related to the need to identify meaningful portions of content and learning, as opposed to more superficial and unimportant facets. Mannion [32] suggests that any act of writing text can be deconstructed to identify the positions that the writer holds valid or important: by focusing on included text, participants may be able to identify missing content or learning that could provide a more holistic perspective.

Weblogs were also important in supporting students in charting and perceiving changes in their thinking. For example, Scott mentioned the ability of Weblogs to chart development of thoughts, which allowed him to understand how old and new knowledge became integrated. This finding is consistent with research on the utility of diary writing for distancing oneself from content and practice, and then for subsequently analyzing the content of the diary to identify patterns [see for example, 30]. Mannion [32] describes three phases of journal writing; in the first stage, before learning occurs, students tend to provide tentative, initial understanding of content. In the second stage, which is seen as a pause in the learning activity, journal writing allows students to reflect on what has been learned. In the third stage, students can connect reflections to other understanding. Comments by Cathy and Scott indicate that they perceived changes in their learning and development. In this context, Weblogs can be viewed as an artifact that mediates reflection and allows one to return to a specific experience [see for example, 23].

The second major theme in the positive experience of Weblogging was identified as the sense of community that developed from exposure to others' Weblogs. However, perceptions of community differed. Cathy's perception, for example, was more related to a sense of togetherness and belonging generated by the Weblogs. This conceptualization of community matches a definition offered by Unger and Wandersman [as cited in 33, p. 321], where community refers to "feelings of membership and belongingness." Scott's definition of community, on the other hand, referred to both an affective and a learning component. He perceived the Weblogs as reducing loneliness and increasing a sense of togetherness in striving for a common goal. While this affective component of community bears some similarity to the feelings expressed by Cathy, Scott also overtly referred to the concept of a "learning community" and the role of Weblogs in stimulating mutual growth. Rovai [33] identifies two components of a classroom community—connectedness and learning. A sense of connectedness accrues from one's perception of membership within a community, which is usually accompanied by feelings of belonging, acceptance, and the creation of relationships. Both Scott and Cathy referred to this aspect in their perception of community. Scott also referred to "struggling to understand this together." Paloff and Pratt [34] use the term "connectedness" in the sense indicated by Scott, where it connotes knowing through shared struggles with course material and the medium of learning. The learning component of the community was overtly mentioned by Scott and included the perception that knowledge and meaning construction are integral processes within the community, which is consistent with Paloff and Pratt's [34] conception of a learning community where members perceive a common learning goal and expectations.

Current research on learning communities is often related to online and distance education contexts [see for example, 34], but a sense of community has been identified as important for fostering learning and a sense of belonging in face-to-face settings as well [35, 36]. A feeling of community may result not only in reduced feelings of isolation but also in increased motivation to learn [37]. In his research, Rovai [37] indicated that a higher sense of community was correlated with higher self-perceptions of learning, which to some extent matches Scott's perception of his learning. The other contribution of Weblogs to a sense of community was the ability to extend and generate conversations based on student comments. Participants perceived this extension to be valuable in furthering communication. Definitions of community are often closely tied to the level of interaction between participants [38], and Paloff and Pratt [34] suggest that evidence of student-student rather than instructor-student conversations are indicative of a learning community.

In summary, participants appreciated the ability of Weblogs to support their thinking and also appreciated the sense of community that emerged through the Weblogs. Participants used the Weblogs to spontaneously archive reflections, chart their progress, and reflect on their growth. In addition, reading others' reflections challenged individual thinking and contributed to a sense of closeness. However, Weblog usage also engendered some negative experiences that are described in the next section.

VIII. NEGATIVE EXPERIENCES ABOUT WEBLOG USAGE

Apart from the positive experiences, participants also expressed some hesitancy and negative feelings regarding Weblog usage. For many participants, this course provided the first opportunity to use Weblog technology and unfamiliarity with its usage led some participants to feel stressed. Participants were also concerned about the instructor's lack of guidance on format and frequency of Weblogging. Another negative perception about the use of Weblogs was participants' concern about their lack of content knowledge. In addition, because the Weblogs were open to public scrutiny, participants expressed concerns about safety of the environment.

A. Uncertainty about Correct Usage of Weblogs

For 7 of the 8 participants, the design course was the first opportunity to use Weblogs and they expressed uncertainty about correct usage of the technology. Tom, for example, felt that his lack of technological knowledge resulted in a feeling of stress, and since he was "new to it… so there was pressure of doing it right and correct." He also mentioned that unfamiliarity with the technology and the practice delayed and decelerated his Weblogging.

For three other participants, the novel technology combined with their lack of understanding about its usage to support learning resulted in engagement in the Weblogging activity purely for the purpose of meeting the class requirement: Thus, Weblogging became a somewhat stressful experience. Jack mentioned that the "external pressure" increased the difficulty of the task and interfered with his ability to post. He also felt that for some students the pressure resulted in their posting "something just to meet the assignment but not reflecting." He suggested that this attitude was especially true for those students who valued neither Weblogging nor reflection. Eric suggested that lack of time affected his Weblogging, since he was busy with other courses and it was thus "stressful to figure out something to write there." Tom, because of all the things he had to do, said that he "ended up making a response in despair."

Another concern was the unavailability of specific structure and guidance about Weblog usage and practice from the instructor. Participants' lack of prior experience with the technology led them to expect procedural and content guidelines for using the Weblogs. The lack of structure frustrated Betty who found

it difficult to identify the important topics for reflection.

> There was no definitive, "this is what you have to do, I want you to write about this topic or tell me your thoughts on this in particular." It was so open that when you have no limitations, it's hard to figure out what you write, what should be public knowledge, and what you keep private, and what the instructor feels is meaningful as compared to what is nonsense. It was hard because there were no guidelines. So it was frustrating in that sense.

Jane similarly felt that the lack of structure was disappointing and depleted her motivation and inspiration after a few weeks of trying to Weblog.

B. Differences in Familiarity and Experience with Content

Participants indicated that their prior content knowledge (or lack thereof) impacted their practice of and ability to engage in Weblogging. Participants who possessed more content-related experience were generally more active with Weblogging, while novice participants encountered difficulties in identifying areas for exploration or connecting information to their prior experiences. Eric mentioned that being a first semester student, he found it difficult to find something to write about since he "didn't have enough information or knowledge." In contrast, Betty had some prior teaching experience that she used to guide her writing and she mentioned its utility in helping her write on the Weblog: "I had a lot teaching experience and I would cite experiences. That really helped make sense of a lot of instructional design."

Differences in students' backgrounds posed difficulties for some participants because of their inability to connect with unfamiliar experiences or contexts expressed by other classmates; they found the content of such writing difficult to understand and apply to their own situation. Eric identified the Weblog as being personal and suggested that it might thus "be very difficult to evaluate by others." Because of the personal tone of Weblogs, Eric found it "difficult to give some idea, or to respond to others' thoughts or writing." Betty said that she perceived others' Weblogs to be at times frustrating and at other times helpful, depending on the writer.

> And it's sometimes more frustrating to read other people's ideas when they are well beyond yours. And sometimes it helps because they might say something that clarifies for you. But they also may say something that makes you just more confused…the gentleman I worked with was military based, so all of his analogies were based on military. And I am not a military person. I don't necessarily understand military speak, so some of the things that he made correlations to I don't understand at all because it's not even in the realm of experience or understanding.

C. Concerns about Privacy

One participant, Scott, expressed doubts about the security of the environment because of its potential to be viewed by anyone with Internet access. Theoretically, anybody could respond to the writing on the Weblogs, and Scott was particularly afraid of attacks on his ideas without proper reasoning and factual backup.

> Those who would offer "insights", I put that in quotes, that was not founded upon anything as you can tell is almost, in one sense, reaction of deeply held personal beliefs which are fine as long as they would have the opportunity to reflect upon themselves, inspired by research, not just something you think is right or wrong but why do you think is right or wrong. You disagree with

> me, that's fine, but tell me why. Just don't attach something and offer no reason as to your justification.

Scott was also concerned about the attention to be given to responses by unknown individuals, since he found it difficult to trust the sources, not knowing the background or expertise of the person.

> … if you don't know the person via the Weblog… to the depth and credibility of their arguments or their thought, then I was skeptical and I was skeptical posting mine 'cause somebody who had no, very limited knowledge would respond something then I don't know how much impact I should take that.

While Scott expressed a level of distrust of the environment that was not as apparent in other participants, the public nature of the Weblog caused some concern for other participants too. Participants were cautious about topic selection and chose not to write about anything personal, anything "too controversial" or too negative. Three participants expressed concerns about posting items related to the actions or opinions of peers. Lisa refrained from posting group or personal issues on the Weblog, and chose to keep a "professional orientation," eliminating personal issues and problems. Jane expanded on this concern and said she was "cautious" about posting a comment on any controversial issue.

IX. DISCUSSION ON NEGATIVE EXPERIENCES OF WEBLOG USAGE

Participants expressed negative perceptions about Weblog usage for three main reasons: 1) the lack of explicit structure and guidance for blogging practice, 2) different levels of expertise with content and context, and, 3) concerns about privacy. Brockbank and McGill [24] note that engaging in reflective thinking requires provision of explicit space and time and provision of structured guidance on the format of reflective thinking and discourse. In this study, lack of guidance was associated with both procedure (i.e., how much to post and how often to post) and content (i.e., what specific content to address). In his research with pre-service teachers' journal writing, Garmon [10] identified that the imposition of a specific procedural requirement (twice a week with a minimum length requirement) was appreciated by some students but not by others. Some students felt that the guidelines were too restrictive, leading to journaling about unimportant issues. Similarly, students varied in their appreciation of the establishment of specific content foci: some students requested more freedom on topic selection, while others requested constrained topic starters to focus their writing. This disparity in opinions is similar to that expressed by participants in this study. While some participants mentioned that the lack of guidance was stressful, they were nevertheless able to Weblog successfully, while other students were unable to Weblog without a specific structure.

Korthagen [39] identifies this difference in student needs as a difference between internally oriented students who prefer to reflect using their own experiences and externally oriented students who prefer to be given guidelines and instructions. Korthagen also suggests that externally oriented students should be given safety and structure in the form of the instructions that they require. Jasper's [11] research indicated that two types of structure were important: one element of structure focused student attention on important aspects of their learning and the other element was the development of a structured writing format. In Jasper's study, students became more adept at engaging in reflection because they developed a practice of recording reflection and also because they were given explicit parameters focused on their learning. However, willingness to engage in reflection differs among individuals, and those who value reflection are more likely to engage in the process deeply [40].

The second hesitancy related to blogging was occasioned by different levels of context and content expertise. Contextual expertise in this case refers to the use of Weblogs and attendant technologies. Earlier research on the role of technological tools designed to support student learning has identified the importance of introducing students to the purpose and use of different types of tools [41, 42]. Thus, an introductory session might have induced students to blog more consistently regardless of prior experience with such technologies. Content expertise is more concerned with the integration of prior experiences as identified by participants. Those participants who were able to relate prior experiences to current content were more successful in blogging by drawing comparisons and engaging in more reflective thinking [43].

Concerns about privacy were also cited for lack of Weblog usage. Weblogs can be read by anyone with access to the Web. The wide access to private reflections and thoughts can be disturbing to some students [13] and specific attention must be paid to ethical and personal considerations of Weblogging. Weblogging shares much in common with student feelings about journaling. For example, Ballantyne and Packer's [9] research with doctoral students' journal writing indicated that students generally perceived journals as a safe space for expressing their ideas and feelings, but when they were exposed to an audience, they felt a need to be more circumspect in their writing. A similar perception was reported by participants in Spalding and Wilson's [44] research, where although participants appreciated others' feedback in broadening their views, they were still hesitant to share their private thoughts with others.

In summary, negative experiences related to Weblog usage were related to participant lack of knowledge and guidance about appropriate usage, lack of content knowledge, and concerns about privacy. Participants suggested that these experiences resulted in sporadic and inconsistent blogging.

X. IMPLICATIONS FOR RESEARCH AND PRACTICE

The initial themes that emerged through this exploratory study of students' experiences with Weblogs provide some important avenues for further research and practice. Weblogs are similar to paper-based journals in that writing is the singularly important expression of reflection. Also, Weblogs and journals offer a consistent space for individual reflection. As we noted in this study, however, students continue to encounter difficulties with consistently writing on Weblogs. Three primary research avenues are implied by the results of this study: (1) exploring methods to encourage student discourse with other peers in the instructional community and examining their effects on student reflection; (2) encouraging engagement in appropriate types of writing to aid learning and reflection; and, (3) identifying strategies to engage students more consistently in reflecting on the Weblogs.

Study participants indicated that they appreciated access to varied perspectives and one area of exploration should focus on different mechanisms for encouraging students to integrate various information sources into their writing, as well as to encourage them to publish comments to a wider audience. These sources may include peers within an instructional setting as well as members outside the immediate learning community. By expressly soliciting commentary and feedback from a wide audience, student reflections are likely to become more evaluative and critical [24]. Descriptive research of implementations that encourage Weblog interaction might help to identify appropriate strategies that encourage students to create thoughtful, critical reflections. Another valuable research avenue is the examination of the effects of others' commentary on the quality of student reflection. For example, how is quality of reflection affected by more or less commentary from others? Or, how is a student's own reflection affected by giving commentary to other peers? Privacy of thoughts emerged as a significant concern for some students and prevented very detailed posting of thoughts. This concern may impact student ability to receive and provide feedback as previously suggested. Instructors and designers may be able to mitigate this barrier by emphasizing the content-focused (and non-personal) nature of reflection. Research-based, practical strategies may also allow students to gain experience with providing

constructive critical commentary, and perhaps alleviate any tendency to correlate feedback with personal attacks.

Research should also be directed at developing student ability to engage in writing. In this study, some participants mentioned writing for an audience, which connotes engagement in transactional writing [31]. Researchers and practitioners should identify how to encourage students to participate in both informational and transactional writing, thereby combining personal meaning-making with thoughtful expression in the form of discipline-sanctioned discourse. In addition, researchers may fruitfully investigate the impact of different writing types on the quality of reflection and learning.

Another area of exploration concerns the identification of specific mechanisms, strategies, and practices to encourage student reflection on the Weblogs. Earlier research indicates that students vary in their need for structure and guidance [10, 39] for reflection. Some learners may be more likely to engage in and appreciate reflection [39, 40], while others might find reflection to be challenging or useless, as illustrated in this study and in a study by Garrmon [10]. Thus, research should focus on identifying the types of strategies that prove effective for encouraging reflection from different types of learners. For instructors and designers, the practical challenge is to identify an appropriate balance of structured and unstructured phases of reflection. One method might include supporting initial student logging with directed prompts and then gradually fading the support as the students gain competency and confidence in Weblogging and reflecting. Another option might be to design varied support mechanisms for reflection and allow students to individually choose an acceptable level of structure; however, the challenge is to encourage students to develop their own skills for engaging in structured reflection focused on their learning and interests. This study indicated that Weblogs allowed students to chart their learning progress. Building on this initial finding, it would be useful to identify additional aids to help students to further construct their learning and reflective activities. For example, a combination of Weblogs and concept mapping activities might allow students to map their learning in a more concrete fashion, thereby linking individual posts into a more holistic picture of content learning.

From a very practical perspective, study participants mentioned that lack of knowledge about Weblog technology negatively influenced their ability to reflect. Student use of tools and technologies tends to be circumscribed by instructor demonstrations [e.g., 45]; however, the lack of orientation on specific uses of technological tools and supports leads to unproductive use [46] and sporadic use as demonstrated in this study. Thus, it is important to include initial orientation sessions on the use and purpose of Weblogs to support consistent, appropriate use. An introductory session to basic practices and technology features can be supplemented by additional expert help as needed. In addition, descriptive user-centered research can identify additional technological features that may be effectively integrated in Weblogs to support students in their writing and reflection.

XI. DESIGN IMPLICATIONS

Based on the findings from the reported study, we designed a subsequent study that was aimed at augmenting positive and mitigating negative experiences of Weblog usage. We also planned to collect data to examine effects of using Weblogs on student learning. Our new design tried to address the need for students to blog regularly on course content. Thus, we increased the amount of points allocated to blogging to 25% of the overall class grade. The assignment of grade points was in contrast to the previous study, where we assigned only 10% of the grade for Weblogging. We also designed a blog guide, a three-page description of why the blogs were important to the course and student learning, how to write blogs (technical description), and what they should contain. The blog guide was developed based on our findings in the reported study.

For example, since Weblogs were perceived to positively affect thinking and learning through examination of content, we provided a list of questions to be addressed every week in the blogs, thereby ensuring that students could explore content systematically and deeply. We designed the questions to probe students' content understanding as well as their experiences of applying concepts to authentic situations, and our underlying goal was to encourage students to reflect on the questions and elaborate their thinking through blog posts. Another design option was based on our finding that Weblogs were perceived as being helpful in providing access to different viewpoints. Thus, we made it mandatory for students to integrate outside resources in their weekly writing, and we emphasized the need to integrate peer ideas and thoughts in their posts. The negative perceptions of Weblog usage, such as uncertainty about usage and concerns about privacy, were addressed primarily by providing a list of weekly questions and mandating weekly blog posting. Also, since the emphasis was on writing and reflection related to class content and learning, student concerns about privacy of personal expression was mitigated. Data sources for the second study included both interviews and blog artifacts, and while analysis is still ongoing, initial findings suggest that students found the blogging useful for charting learning and knowledge construction, and especially for creating learning artifacts that synthesized blog posts. Even students who entered the course with the initial assumption that the blogs would be unhelpful changed their views during the semester and commented on the utility of the blogs for charting their learning. Thus, proper design and implementation is paramount to successful use of Weblogs for learning.

The role of the instructor is important during implementation and design of any learning environment. Specifically, instructors who plan to implement Weblogs in their classrooms must address a few pedagogical and administrative questions in planning the use of this technology. Pedagogical questions deal with the utility and integration of Weblogs for student learning within the class context.

a. Have students been made aware of how Weblogging can help their thinking, reflection, and learning?
b. Do the Weblogs support writing and reflection that is integral to understanding the content?
c. Do the posts generated on the Weblogs form an integral component of the assessment or learning artifacts generated by the students?
d. Is there a requirement in place for students to blog at regular intervals?
e. Is sufficient assessment credit allotted for the Weblogging activity and posts?
f. Are trigger questions or some type of support mechanism provided for students to blog at regular intervals?
g. Are trigger questions directly linked to class content and learning artifacts?
h. Is there a requirement for students to read outside resources and blogs for integration within their own writing?
i. Are students directed to focus on content and learning as opposed to personal feelings?
j. Is there an emphasis on respectful, supportive, and critical commentary on the Weblogs?

Administrative questions to be addressed are about technical support for and maintenance of the Weblogs.

a. Is there an expert who can provide technical support and guidance to students as they use the Weblogs?
b. Is it more convenient to use a paid or free blogging server?
c. Is the blogging service easy and transparent to use?

d. If additional media like audio (audioblogs) or video (videoblogs) are to be used, has sufficient server and bandwidth space been identified for use?
e. Has an orientation session been planned for informing students how to set up a blog and post items?

Using these questions as a guide, instructors who plan to use blogs for the first time within a classroom setting can do much to circumvent negative experiences and enhance the positive impacts of Weblog usage for student learning.

XII. CONCLUSION

As a new and potentially powerful technology, the parameters and consequences of Weblog usage within higher education are still unexplored. Understanding graduate students' experiences of their Weblogging activities can impact the design and use of this technology in higher education settings. Especially, if Weblogs are to support specific types of thinking or collaborative practices in educational settings, student use and perceptions of the technology are important in informing practical and empirical educational implementations. We have presented some initial themes regarding the positive and negative experiences of students' Weblogging activities. This initial data supports the proposition that Weblogs can be used to support reflection individually; however, data also suggest that a more structured and guided introduction to the usage of this technology would be conducive to inculcating early and appropriate usage. Further research can explicate mechanisms and strategies by which Weblogs can be used to foster individual and group reflection and to create a sense of community, while avoiding situations that students might find threatening or disengaging.

XIII. ABOUT THE AUTHORS

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ESSENTIAL ELEMENTS IN DESIGNING ONLINE DISCUSSIONS TO PROMOTE COGNITIVE PRESENCE — A PRACTICAL EXPERIENCE

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ABSTRACT

Online discussions have been increasingly integrated into face-to-face classes at universities to enhance student learning of course content. The primary focus of past research has been on the end products of online discussions. Studies reported either successful findings or results that fell short of desired learning outcomes. An in-depth investigation is needed about how the design of online discussions is related to success. This paper reports our experiences in conducting a three-phase, design-based study: (1) designing the online discussion activity; (2) implementing our design in a university course; (3) empirically investigating our design.

KEYWORDS

Cognitive Presence, Asynchronous Online Discussions, Design-Based Research

I. INTRODUCTION

The use of online discussions is gaining momentum in university classrooms. It is widely recognized that online discussions have the potential to cultivate and develop student higher order thinking skills [1, 2, 3, 4, 5]. However, due to inappropriate designs, many online discussions failed to achieve desired learning outcomes [6]. "OL might have great potential to promote critical thinking, however, to implement OL, and especially online discussions in a way that actualize this potential has proved to be a real challenge" [7, p. 808].

Instructional design plays an essential role in determining successes of online discussions [8, 9]. Higher order learning through online discussions requires more than "undirected, unreflective, random exchanges and dumps of opinions" [10, p. 14]. It requires the systematic approach in designing a meaningful context wherein students practice higher order thinking skills purposely.

Aviv's study [1] demonstrated that appropriate design was imperative in promoting knowledge construction in online discussions. With careful design and structure, students took an active role in constructing knowledge. Student online discussions consequently reached a high level of cognitive engagement. Without proper design and structure, students took on a passive role in the discussion; their cognitive engagement was low.

The primary focus of past research has been on end products of online discussions. Studies either reported successful findings or described results that fell short of desired learning outcomes. An in-depth investigation is needed about how the design of online discussions is related to success or failure.

In this paper, we report our experiences in conducting design-based research that contains three essential components: (1) the design of the online discussion activity, (2) the implementation of our design in a university course, and (3) the empirical investigation of our design.

Design-based research fits well with our purpose of improving teaching and learning with online technology. Education is by nature a designed intervention [12]. Wang and Hannafin [13] defined the design-based research as "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" [12, p. 6, 7]. Design-based research can trace back to the work of Brown [14] and Collins [15]. Design-based research as an approach was conceived out of their concerns that laboratory studies of instruction interventions are limited in addressing the dynamics, complexity, and messiness of learning processes in real classroom settings. In recent years, design-based research has gained popularity as a form of educational research for those who attempt to improve student learning in real classroom settings through designing educational interventions, especially involving the use of technology [15, 16, 17, 18]. Design-based research has five basic characteristics [13]:

1. Design-based research is pragmatic. Researchers investigate practical issues to seek understanding about design, theory, research and practice. Design-based research considers that good theory informs and improves practices.
2. Design-based research is grounded. In design-based research, researchers ground design in theory and implement the design in real-classroom contexts.
3. Design-based research is interactive, iterative, and flexible. Design-based researchers form interactive collaboration with practitioners. The processes involve an iterative cycle of design, implementation, research, and redesign. Design processes are flexible to allow emerging insights to be incorporated.
4. Design-based research is integrative. Design-based research integrates a mix of research methods both qualitative and quantitative to increase its objectivity, validity, and applicability.
5. Design-based research is contextual. Results of the design-based research need to be connected with both the design process and contextual factors of the setting where the research is conducted. Researchers need to document the design process, research findings and changes from the initial plan in detail so that other designers and researchers can examine research findings and trace contextual factors and conditions that led to the findings.

We believe that online discussions have the potential of promoting student higher order learning if designed appropriately. We decided to experiment with online technology in our course and believe that the empirical study of our design will provide insights that will directly feed back into our next design cycle. The inclusion of design, practice, and investigation in design-based research allowed us to lay out our design, implement the design in a real class context, and empirically study the efficacy of our design.

II. DESIGNING FOR COGNITIVE PRESENCE

A. Cognitive Presence

Garrison, Anderson, and Archer [10] considered that all successful online discussions should promote cognitive presence. Cognitive presence describes the extent to which learners are able to construct knowledge through reflected discourses in a critical community of inquiry [10, 16]. In supporting cognitive presence, two other elements are essential: social presence and teaching presence [10, 19, 20]. Social presence is defined as the level of a sense of belonging thought which participants project themselves as members of a community. Social presence is a feeling of togetherness and mutual awareness [21]. Teaching presence refers to designing and facilitating learning [11].

We designed and implemented the online discussion activity in a graduate level course, *Training Methods and Strategies,* at a university in a Southeast Asian country where English is the official language. There were 20 students enrolled in the class. Class discussion was an essential component in this course. The major purpose of carrying out class discussions was to promote student learning of various issues in the field of training methods. It was hoped that class discussions would stimulate active thinking, bring in multiple perspectives and provide students opportunities to apply what they had learned to interpreting various issues in training methods and strategies.

The electronic discussion board was incorporated into the course as a medium for discussions. The online discussion overcomes some of the limitations of face-to -face class discussions. Its around-the-clock accessibility extends discussions beyond classrooms, and it allows one-to-one, one-to-many, and many-to-many interactions. Compared with spontaneous and transitory face-to-face class discussions, online discussions are text-based and more structured, providing students time to formulate thinking and compose postings, thus helping to promote student higher order learning [22, 8, 23, 24, 25]. The text-based feature of online discussions makes student thinking visible and leaves a permanent written record for student later review. "Text-based communication may actually be preferable to oral communication when the objective is higher-order cognitive learning" [19, p. 91].

B. Analytical Framework for Design Elements

The effective design requires a systematic approach. First and foremost, we need to identify design elements. What are essential design elements that govern the online discussion activity? Activity theory is the analytical tool we use for identifying design elements. Activity theory is a powerful framework in instructional design, especially in designing human-computer interactions in socio-cultural contexts [26].

Activity theory has its root in the work of Vygotsky. His pioneering work on learning in social-cultural contexts established the foundation for modern activity theory. Activity theory has the basic structure that contains (1) Subject; (2) Object; (3) Tools; (4) Rules; and (5) Roles. The subject is an individual or a group involved in the activity. The figure [27] below displays the basic structure of activity theory. The bold lines in Figure 1 represent mediation. Tools mediate between subject and object. By being incorporated into the process of human activity, tools help shape and alter human behaviors carried toward the object. Rules mediate actions of subjects endorsed by the community and regulate interactions within the group at both the individual level and social level. Roles refer to the division of labor and mediate among group members. Figure 1 displays the interconnectedness of the components in the basic structure of activity theory.

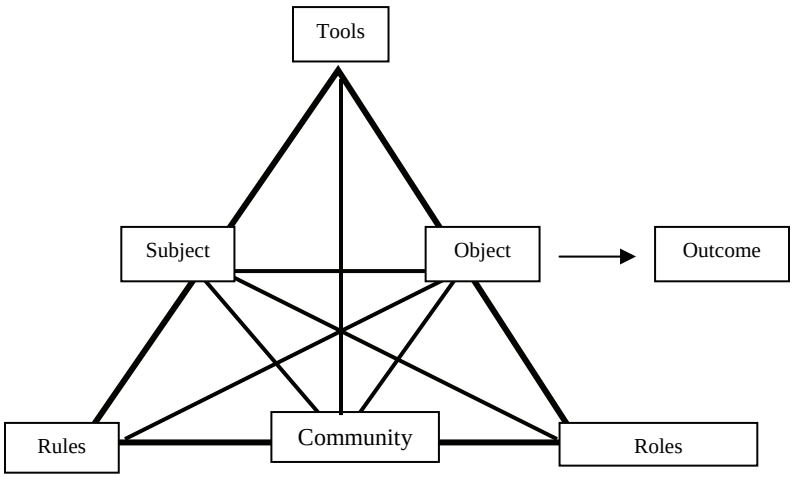

Figure 1. The Activity System [27]

By using activity theory to analyze e-learning communities, Hung and Chen [28] observed that object and rules exert great influences in shaping participants' behaviors. The object determines the way the activity is carried out; the object constantly interacts with the subject and the community, providing them directions, validating the community's efforts, and helping participants make sense of their actions. Rules determined the use of tools and roles. When rules are appropriately designed, from which the roles and tools are dictated, in-depth learning transactions would likely be actualized. In general, Hung and Chen [28] considered that object is the top level in the hierarchical structure of the Activity System. Rules are on a higher level of significance in the hierarchy compared with tools and roles.

Based on their observations, Hung and Chen [28] redesigned the system by altering the activity structure. Figure 2 [28] displays the re-conceptualized activity structure.

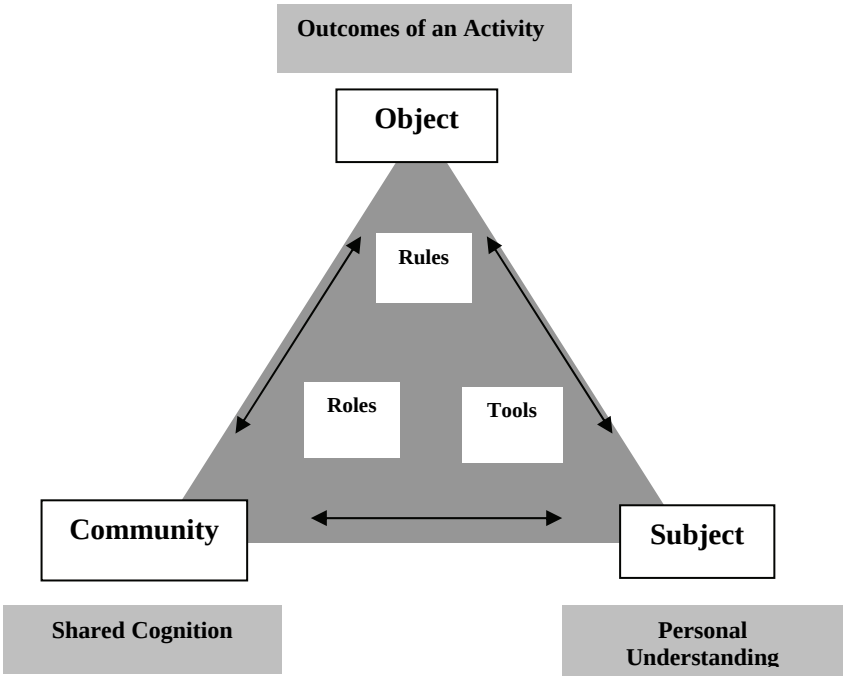

Figure 2. The Re-Conceptualized Activity System [22]

The online discussion activity reported in this paper was designed using the reconfigured activity structure. We placed great emphasis on designing the object/learning outcome of the activity and the ground rules that dictated the discussion activity.

C. Design of the Value-Added Object

The object/learning outcome was the ultimate goal that the discussion activity was to accomplish. To facilitate its accomplishment, it was essential that students make sense of the object and bought into its value. Without a clearly defined object, the online discussion tended to lose its cognitive essence and digressed to unfocused communications. Lave and Wenger [29] considered it imperative that participants had shared interests and made sense of their joint efforts.

We considered that the object of the online discussion activity needed to be tied to the overall learning of the course. Research showed when students perceived the online discussion as irrelevant to their overall learning in the course, they did not engage in meaningful interactions [25]. Students posted to satisfy the minimum course requirement. Their interactions were one way rather than two ways [2]. A study by Oliver and Shaw [30] found that students were actually playing a game of assessment; they posted messages to earn credits. The assessment rule motivated students to post messages; however, the rule failed to motivate students to engage cognitively in discussions.

We aligned the object of this online activity to one of course assignments that students conducted research on a topic in training methods and strategies and presented their findings in class. This assignment was a group project. Students formed two-person groups. The online discussion was employed to scaffold students in completing this assignment. Students were required to post their topics, preliminary research, and their assertions on the discussion board. The class would then interact on these topics. Students would use input from discussions to revise and refine their research. Each group was required to incorporate the input from their peers into their final presentations. We hoped that this value-added object would have students perceive the activity in the context of a larger and more global picture. We designed this value-added object to facilitate formation of commonality and interdependence that were two essential features in building learning communities [29].

Commonality refers to learners' shared goals and expectations for learning [31]. Commonality helps learners to make sense of their collaborative work. One major interest commonly shared by students was to complete course assignments and present high-quality work. We situated this online discussion in the context where it was used to help students perform well in a course assignment. In successful learning communities, all the participants had a stake in their investment of time and efforts and made sense of their investment with respect to each other [32]. It was expected that students would be bound to work together by this commonality.

Interdependence emerges when learning requires differing competence levels of expertise and perspectives from participants. One team member's success depends on his/her peer's success [33]. "Interdependence is the mutually negotiated and accepted way of interacting among the parties with the recognition of each other's perspective, interest, contribution and identity" [34, p.147]. The accomplishment of the desired object of this discussion activity required collective intelligence and collaborative work. The task was simply too difficult for a single person to accomplish. Students depended on the diverse expertise of their peers in pursuit of the desired learning outcome.

D. Design of Ground Rules

1. Rules to Support Cognitive Presence

Rules support the object of an activity. The purposes of this online discussion were to engage students cognitively and support strong cognitive presence. By participating in online discussions, students were expected to achieve better command of various issues in training methods and strategies.

A literature review was conducted to identify problems that hinder student learning in online discussions. Frequently cited problems included non-participation [6, 35, 36], postings that did not reflect critical thinking skills [6, 25, 37], limited interactions among participants [30] and topic digression to unfocused talks [6, 38]. These problems severely encumbered cognitive presence in online discussions.

Research showed that student participation has positive association with learning outcomes in online activities [39]. Cognitive presence is actualized by student active participation. Nevertheless, student participation was a problem, even though the online discussion allowed students to have anytime-and-anywhere access [36, 40]. A few students might post, while other students have been comfortable in being "lurkers," reading rather than contributing to the discussion [41]. When some students did post, they seldom received responses [42]. Therefore, student interactions were rather limited [30].

It remains a challenge to sustain cognitive presence in online discussions. Student discussions often lacked critical components. Student postings were often shallow, superficial, subjective and at times naïve, showing little evidence of critical thinking [43]. Rather than critically evaluating and synthesizing course materials, students mainly exchange personal experiences and retold course materials [25].

Another challenge in promoting cognitive presence is to keep online discussions on topic. Samuel [44] considered this issue a key challenge. Students exerted more control over their learning when they were online than they did in face-to-face learning. In addition, threaded discussions allowed students to follow various threads. As a result, online discussions tended to lose their original focus and digressed to irrelevant talks. Once discussions wandered off track, it would take a long time for the instructor to get discussions under control [38].

We took a proactive approach in designing rules. Rules were designed to promote cognitive presence while avoiding the pitfalls that encumbered student learning in online discussions. When laying down each rule, we identified rationales underlying the rule. Questions that were constantly in our minds were: In what way did the rule support cognitive presence in online discussions? How should the rule be designed to avoid or alleviate the frequently cited problems in the literature? Table 1 displays our rules.

Rules	**Rationale**
Start dates Cut off dates	Level playing field Facilitate student planning
Minimal number of posts — You need to comment on at least two other groups.	Increase number of posts Critical mass

Support your arguments with evidence (established theories, empirical data, thought experiments, etc.).	Prevent garbage messages Promote meaningful cognitive engagement Increase quality of posts
Keep one point per short message	Increase clarity of the structure of messages
If no one answers your posting, you can send invitations to three students for responses.	Legitimacy for response Shortened waiting time
You are not allowed to post before the second deadline.	Useful delay for lurking Increase thoughtful postings
You are encouraged to build on existing ideas by quoting and paraphrasing other people's messages.	Build on each other's ideas Virtual "body language" Expand perspectives of the discussed issues Reduce tension between active and lurking participants
You must always reply to comments to your posts	Increase interaction Greater ownership of discussion
If you have nothing more to add, wrap it up nicely with a concise summary.	Every message matters Proper closure Clarify more ideas Increase student synthesis skill Open new directions for discussion

Table 1. Ground Rules to Sustain Cognitive Presence

2. Social Presence to Support Cognitive Presence

We believe that learning is inseparable from learners' emotions. Within a learning community, learners should feel free to take risks to achieve the desired learning outcome. While promoting cognitive presence, we set up rules in facilitating group dynamic interactions—social presence. These rules were to facilitate building a healthy community of inquiry and developed a student-centered discussion environment.

> This is a place to celebrate our ignorance, imperfection, confusion and struggles.
>
> Keep the discussion informal
>
> You are strongly encouraged to try ideas that you are not yet certain of (dare to risk).
>
> Keep messages short and sweet.
>
> Be constructive! It is always possible to disagree
>
> Do not spare your compliments. Be encouraging and constructive.
>
> Questions can be powerful contributions. Sometimes, you don't even have to agree or disagree.
>
> Play the devil's advocate, but do signify your intent in the message.
>
> Do not feel distressed if the lecturer does not comment on your messages. There can be many reasons. For example, the lecturer can be overwhelmed, he/he does not have anything more to add, he/she is waiting for others to try out ideas first, etc.

Our value-added object was also aimed at facilitating the sense of togetherness and mutual awareness of the students in relation to each other. Bound by the shared goal and the need for diverse competency levels of expertise and perspectives in completing the task, students were expected to collaboratively maintain and nurture the formation of the community of inquiry.

Social presence needed to be promoted and nurtured throughout the course. This was a course in which students met face-to-face. The instructor of the course made efforts in facilitating the formation of the community of inquiry throughout the course by allowing students to be the major force in directing their own learning. Students were encouraged to take risks and challenge each other as well as experts, which played a significant role in building relationships among students and increased student comfort level in functioning in the online community of inquiry.

E. Teaching Presence — Teachers as Designers and Facilitators

Teaching presence is binding element in creating a community of inquiry. Fundamentally, cognitive presence and social presence largely depends on the presence of a teacher [20]. The text-based environment differs from face-to-face environment in that it has low teacher immediacy. Teachers and students are separated physically. Teachers are not always available when needed. Therefore it is more important to promote student autonomy in online discussions. Using activity theory as the framework, we focused our efforts on designing the valued-added object, rules and social norms. Bound by the shared object and guided by the rules and social norms, we believed, spontaneous facilitation among students would emerge. Students would be able to take responsibilities for their own learning. We decided we would move ourselves to the side and invite students to take the center stage. Students would be the ones to take charge, initiating dialogues, keeping the discussion focused, stimulating discussions, encouraging and supporting each other and resolving group conflicts. Although we would monitor the discussion closely, we had decided that we would not intervene unless absolutely necessary.

III. RESEARCH METHODS

Content analysis was used to measure cognitive presence in student online discussions. The unit for analysis was based on the message level. Research confirmed that content analysis based on the message level was the reliable method to assess cognitive presence in online discussions [11, 45].

Garrison, Anderson, and Archer [11] used content analysis to measure cognitive presence and developed a coding system that was applied in research on cognitive presence in online discussions [3, 45]. According to their analysis, Cognitive presence progresses and develops through four stages: triggering, exploration, integration, and resolution (table 2).

Category	**Indicators**
Triggering	Recognizing the problems Sense of puzzlement
Exploration	Divergence within online community Divergence within single message Suggestions for consideration Brainstorming Leaps to conclusions

Integration	Convergence among group members Convergence within a single message Connecting ideas and synthesis Creating Solutions
Resolution	Various application to real world Testing solutions Defending solutions

Table 2. Cognitive Presence [11]

In this study, cognitive presence was operationalized through three stages since the resolution phase was not applicable in our case. Olszewski [46] pointed out that "it may not be appropriate for resolution to be the outcome of a single course" [46, p. 117]. The students in this course would not test their solutions in real world situations. The final product of the discussion was a class presentation. Please note the definition of resolution and do not confuse it with that of group consensus that is included at the integration stage. All the student postings were archived and analyzed based on message-level units. Messages were categorized into the three phases of cognitive presence: triggering, exploration, and integration.

Inter-rater reliability was established in three phases. First, 10% of the messages were randomly selected. The two researchers independently coded the data. Upon completion, the two researchers discussed the results of the coding. Discrepancies in the coding were identified and the coding rule was refined. For example, if a message defended a previously stated position, it should be coded as "integration." This phase was repeated until 100% agreement was reached.

Second, one researcher completed the coding of the entire data set. Third, another 10% of the remaining messages were then randomly selected for the other researcher to conduct coding. The reliability of data coding of these randomly selected messages was .92.

Upon completion of their class presentation, students were asked to reflect upon their experiences with online discussions by responding to a list of questions. These questions explored student perceptions regarding online discussions. Student responses were examined to provide insights on the efficacy of our design.

IV. FINDINGS

A. Strong Cognitive Presence in the Online Discussion

The students formed two-member groups to investigate an issue in training methods and strategies. They were required to post their preliminary research and assertions on the discussion board. The class responded to the postings. The groups would then use responses on the discussion board in preparing class presentations. The time span for the discussion forum was 20 days.

Student enthusiasm for participation was impressive. In total, this discussion generated 267 messages. The quantity and quality of student postings were indicative of student deep involvement in the discussion. Although students were required to respond to two other group's postings, student contributions far exceeded the required participation. Students reflected that:

> Personally, my participation level went beyond the stipulated minimum 2 posts as I actually read all the postings and responded to things I do not agree with — such as "argument is a character trait."
>
> I was equally excited by the amount of quality discussions that were posted. The numerous viewpoints and concerns that flowed out of the thread are interesting and enlightening. This may be due to the interesting assertions that were being posted. All seem eager to learn about the assertions and help in refining them. Overall, it is a great learning experience.

Cognitive presence was strong in the discussion. Findings are displayed in table 3. Only 6% of messages fell into the category of "Others". Messages in this category were acknowledgements and appreciations of other student contributions. A couple of messages were sent for humorous reasons.

Category	**Number**	**Percent**
Triggering	58	22%
Exploration	111	41%
Integration	83	31%
Others	15	6%

Table 3. Cognitive Presence in the Online Discussion

The following sections detail student participation in each phase of cognitive presence.

1. Triggering

Triggering is the initial stage of cognitive presence. In the triggering phase, 22% of the messages were generated.

The initial stage of the discussion was marked by student inquiries and elementary clarifications. After all the groups posted their assertions and rationales for their investigations, questions started to pour in. Students posted questions to seek clarification or challenge the rationale of assertions. Questions triggered responses. Responses triggered more questions. Sometimes, questions triggered questions.

One group posted their assertion regarding the role of gaming in learning:

> Game-based learning is an effective instructional strategy for learning outcomes that are higher order learning, for example, problem solving". This assertion triggered a series of questions.

There were questions to seek more clear definitions:

> By game-based, are you referring to game in general, which connotes fun? If you are, then I have experienced being taught something in a fun (or game in your term) way but it was to learn some very elementary materials.

Some questions challenged the rationale of the assertion:

> How do you assess effectiveness of game-based learning therefore quantifying the pros and cons?
>
> Is it suitable? If a Subject Matter Expert wants a game-based environment, the first things I'll look at would be: (1) cost; (2) expertise; (3) justification.

There were also inquiries that demanded more evidence:

> Xiang, could you show some evidence or support from learning science that illustrates that gaming helps in higher order thinking skills (in fact based on your response is that gaming can be helpful for lower-order learning outcome as well?) Then we have a clearer idea to assess between yours and Kang's assertion.

Poscente and Fahy [47] considered that strategic initial messages had potential to trigger cognitively engaged discussions. They termed questions that invited discussions as *true triggers*. These questions were open-minded and solicited responses from participants. Questions forced groups to dig deeper into the issues, re-think the rationale of their assertions, and decided on the direction where to take their investigation. Questioning helped the groups to identify logical gaps, one-sided views and new perspectives. In the process to construct clarifications and explanations, students collected and examined evidence and performed analysis and synthesis. Karron Lewis [48] considered that questioning played an essential role in systematic investigations in any field. Questions are used to evaluate reasons for the investigation, to steer the investigation, and to examine results.

2. Exploration

At the exploration phase, students externalized their thoughts, broadening their views of the investigated issues. In total, 41% of the messages were generated in this phase. Through collaborative exploration, multiple perspectives emerged. Exploration was the essential process of socially constructing knowledge. Problems in the real world rarely have one correct solution path. The exploration phase provided students opportunities to evaluate various solution pathways, extending and enhancing student understanding of their investigations. As the discussion progressed, the discourse moved from surface level processing to in-depth level processing. Students externalized their viewpoints, compared their thoughts with that of their peers, and evaluated various claims and arguments. Contradictory ideas, personal opinions, and thoughts that were not quite mature were expressed. One group posted the assertion: "Authentic learning approach is NOT suitable for secondary and junior colleges in our country." In the process of exploration, students discussed various aspects of the issue in the context of their country. Students first brought up confounding issues in various learning modules:

> How to give grades in this case? After going through all these, how do we make sure that they are really the kind of "product" that we want? I have seen students doing a great project, but unable to answer simple questions….Why? Because they didn't internalize the knowledge. They forget…strange, isn't it? On the other hand, students who score A are unable to produce good projects. (Of course there are exceptions, but how many?)

Some students pointed out that teachers were not motivated to apply authentic learning in classrooms because they were pressured to prepare students for tests:

> I hate drill and practice and personally like authentic learning methods. The objective of getting good grades for the kids is set by MOE (Ministry of Education). So teachers are pressured to ensure they get the grades, though I'm not sure what'll happen to teachers who chose a different

> approach form the norm – kinda reminds me of the movies Dead Poets Society and Mona Lisa Smile.

The issue of the hiring system in the country was also raised. Students realized that the shift in assessment should also apply to the job market.

> The current practice is to look at their grades in schools which is the traditional assessment paradigm. Just look at the public sector, when you apply for a job, they require you to fill in even your primary grades. Isn't this product-based rather than process-based? Although an interview assesses in learning process, the key to getting the interview is the product, the grades. I feel if there is to be a shift in assessment, the working world should also be educated on it; if not, they will be looking at the wrong things when assessing potential candidates.

Through communicating diverging thoughts, students started to view the issue through wider lenses. One student posted that the extremity of the assertion made her uncomfortable: "It is like banning marriage for all (akin to secondary and JC students) because we can't measure for sure that married couple are truly, truly, truly blissfully married (akin to the assessment mode is not changed)". Students suggested that the group examine and readjust their assertion:

> Just want to point out your original assertion did not include the point that due to the assessment methods and time constraints, authentic learning has no place in secondary school and junior colleges, although you did try to explain this point in the justification. Maybe you want to refine the assertion to reflect this point.

Rather than viewing the issues from a particular perspective, students embraced multiple perspectives. In the engaging, and often heated discourse, students communicated, negotiated, and reflected.

> In terms of refining my assertion, I have learned that what I believed to be common terms are not so common after all. Different people view technical terms differently. In the process of refining the assertion, the questions and comments made probe me to think deeper into the issue and help in looking at things with a wider len. I could sense that everyone who helped in questioning the assertion is genuinely concerned and interested in the assertion.

3. Integration

Integration is the challenging phase of cognitive presence. In the integration phase, 31% of the messages were generated.

The integration phase was the process in which students reached consensus through collaborative inquiries. Ideas and thoughts started to converge. Students interacted intensively, making references to each other's messages, and building upon each other's contributions. It is a process where students started to internalize various perspectives.

Student messages became lengthy and substantiated. Students elaborated on their thoughts and debated at a deeper level. More importantly, students supported their thoughts and arguments with evidence.

> If you want to place OJT (On-Job-Training) into any of the learning theories that we know of, I would place it under social constructivism. It is about working together with others to learn. The environment or the social circle is an important component.
>
> If you place OJT in Gagne's thinking on domain of learning, I will say that OJT is applicable for all, namely, psychomotor, verbal, intellectual skills cognitive strategies and attitude (Note that they are not listed in term of applicability, simply based on what I could recall…here…). In term of concept learning, OJT should be classified as the best example related to their workflow.
>
> Well, in term of whether OJT is a "simple good learning from the 'master,'" I would say yes if looked simplistically. It should be noted that OJT tends to be a component of apprenticeship, therefore if you look at the apprenticeship model, you could say it is learning from the "master." But our point is that it should not be from the "master" but through a social system whereby they learn from capable peers.

Reasoning with evidence required students to collect, examine, and apply evidence in supporting or disputing claims and arguments. Students identified information resources, assessed the relevance of the information and connected the information with their discourses. Evidence came from a wide range of information sources: course readings, journal articles, web resources, government documents, PowerPoint presentations, workshops, and videos.

As the integration phase progressed, shared cognition emerged. For example, one group posted their assertion: *Computer gaming can impair students' ability to learn and perform*. In discussions, students explored the addiction to excessive gaming, the gender issue in gaming, the age factor, and the potential of gaming in learning. Postings from other groups had the group realize that they should take a balanced approach toward computer gaming.

> I also agree with Hong that originally that our assertion is just "computer gaming can impair students' ability to learn and perform". But things seem to evolve depending on inputs from ALL participants.
>
> Hong has highlighted himself as a good example to have combined/coexisted with "the evils" of gaming, that may have consumed a lot of time, but nevertheless, you have achieved good results in life too. Perhaps the way to life is balanced activities.
>
> I disagree on "Addiction to gaming is simply a manifestation of a person's willpower." I believe a lack of parental control, guidance and supervision plays a more critical role/condition to development of addiction of computer games in the gamers' formative years.

As the result of the discussion, the group realigned their assertion: Excessive time spent on entertainment complex online games takes away time for school lessons.

Data showed that all the groups integrated elements from the discussion into their class presentations, thoughts emerged in the discussions, research evidence was provided by peer groups, and suggestions were followed for refining assertions.

V. REFLECTION UPON OUR DESIGN

In this section, we'll elaborate and reflect on the efficacy of our design based on the findings of our investigation.

A. Value-added Object to Support Cognitive Presence

Critical thinking is both a process and a product. As a learning outcome, critical thinking is best evaluated through course assignments. More importantly, acquiring critical thinking skills can be supported by the use of a tool and facilitated by better understanding of this process [11].

The object for this online discussion activity involved both product and process. The tangible product for this online learning activity was student presentation. The online discussion activity was designed to prepare students for their class presentations. From the process perspective, the object was to use the discussion board as a tool to engage students cognitively and enhance their understanding of investigated issues.

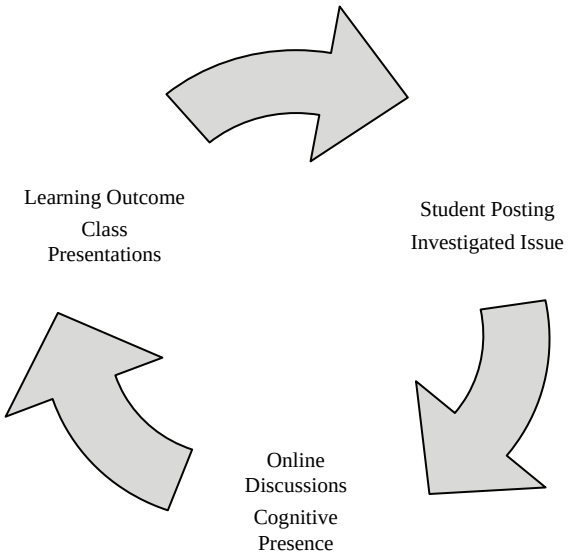

Figure 3. The Multi-phased Inquiry Cycle

Instead of designing the online discussion as a stand-alone activity, we situated this online activity in a multi-phased inquiry cycle (figure 3). The online activity was designed to scaffold students in completing their course assignment. We considered it essential for the online discussion to result in a tangible product, be it a presentation, a paper, or a project. The multi-phased inquiry cycle facilitated student articulation and reflection of their learning. In the process of preparing for class presentations, students related the discussion to the assigned project, evaluating strengths and weaknesses of their arguments as well as those of their peers, synthesizing and integrating discussion components into the class presentation.

The inquiry cycle added reflective elaboration as a dimension to student discourse. The permanent written record of the online discussion allowed students to view and reflect upon the discourse, consolidating various thoughts and arguments into the class presentation. This study showed that the inquiry cycle was effective in promoting the online discussion. The tangible product was an essential element to complete

the inquiry cycle. Without a tangible product, the inquiry cycle would be incomplete, missing a critical component for reflective elaboration.

B. Ground Rules to Sustain Cognitive Presence

The ground rules we designed were effective in enhancing cognitive presence in each phase of the discussion. Frequent problems such as non-participation, superficial messages and topic digression did not occur in this online activity. Comparing with previous studies [45, 49], students in this study generated more messages in the integration phase. There were only 6% of postings classified in the category of "others," which signified the intensity of student concentration on the topics discussed.

Student performance in the discussion was beyond our expectations. Although we required that each student commented at least on two postings from other groups, the majority of students did more than that. There was active interaction across groups. The strong cognitive presence in the discussion showed that students valued this online discussion as an important activity in their learning.

In reflecting upon our rules, we realized that our rules corresponded to each phase of cognitive presence (table 4). This finding has a great implication for setting and refining rules for online discussions. With clear ideas about what to promote in each phase, we can design rules to solve problems in a particular phase of cognitive presence. For example, questions are effective triggers. To encourage students to ask questions in the triggering stage, students might be required to choose controversial topics, rather than topics that are universally agreed upon. In the exploration phase, we should work on rules that facilitate free articulation of thoughts and perspectives. To move students to the integration phase, efforts should be spent in setting rules to help students connect ideas and transact learning to a higher cognitive level.

Rules Supporting Cognitive Presence	Triggering	Exploration	Integration
Start dates Cut off dates	*		
Minimal number of posts – You need to comment on at least two other groups.	*	*	
Support your arguments with evidences (established theories, empirical data, thought experiments, etc.).		*	*
Keep one point per short message	*	*	*
If no one answers your posting, you can send invitations to three students for responses.	*		
You are not allowed to post before the second deadline.	*	*	
You are encouraged to build on existing ideas by quoting and paraphrasing other people's messages.		*	*
You must always reply to comments to your posts	*	*	*

If you have nothing more to add, wrap it up nicely with a concise summary.			*

Table 4. Rules Corresponding to Phases of Cognitive Presence

In analysis of rules with respect to the findings, we considered we benefited from several design principles we followed:

1. Initial Postings Are Essential

Initial postings set the standard and quality for later postings. Cognitive presence needed to be built into initial postings. For initial postings, we required students to post their assertions regarding an issue on training methods as well as justifications for assertions based on research evidence. Students needed to do some initial research in framing their assertions. They needed to access, analyze and evaluate relevant research in formulating their assertions. Assertions as such solicited higher level of cognitive responses and directed participants to *reason with evidence* in their responses.

2. Rules Need to be Made as Specific as Possible

While making rules, we attended to specifics. Only when the rules were made specific, could students know clearly the expectations of them and follow the rules accordingly. For example, what counted for *reason with evidence*? We specified the evidence as "established theories, empirical data, thoughts experiments, and personal experiences." Examples could help illustrate rules and make rules easier to follow. Since all the student messages were archived on the discussion board, it should be fairly easy to select examples to be used in future classes.

3. Flexibility Needs to Be Built Into Rules

Rules and flexibility were not exclusive to each other. In making rules, we infused a level of flexibility by providing students options. For example, students were required to respond to every message sent to him/her. This rule ensured student participation and interaction. However, students might have run out of what needed to be said at times. In this case, we allowed students to wrap up the topic to summarize the thread. This rule worked well. It kept the discussion flow while allowing students to operate their cognitive skills such as analysis and synthesis.

C. Social Presence to Support Cognitive Presence

Social presence in the discussion contributes to cognitive presence. Social presence helps students project themselves as members in this online learning community. Learning is affective and emotional. Social presence has great influence on learning outcomes [50]. Learners learn best in an environment where they have a sense of connection and feel free to take risks.

We set rules to promote and support social presence. These rules helped to create a democratic and relaxing environment. Students voiced their thoughts freely. For example, in the exploration phase, ideas and thoughts were often not quite mature. However, students were willing to take risks, testing their thoughts and arguments, which indicate that students were comfortable in interacting with each other. Students questioned, challenged and debated. Uneasiness and offenses found no place in this community of inquiry. The discussion environment was democratic and student-centered where cognitive presence was accomplished through collaborative critical inquires.

D. Teaching Presence to Support Cognitive Presence — Faculty as Facilitators vs. Students as Facilitators

Our design was successful in promoting student autonomy in the online discussion. Hung and Chen [28] hypothesized that roles were dictated by the object and rules. Bounded by the object and rules, students took the role of facilitators in this discussion. The instructor did not send any messages to urge students to post. Throughout the discussion, the instructor only intervened twice to clarify concepts. Students were the ones in control, taking initiatives, debating on differing thoughts, encouraging and supporting each other, keeping the discussion on topic, and moving the discussion towards the desired object. Student postings centered on the three phases of cognitive presence. For example, one student was not sure whether her posting was on the track, she started her message apologizing: "Forgive me if I have side-tracked from the discussion." Another student responded immediately: "There is nothing to forgive, as these are all done in just good-nature, isn't it?" This example showed that students were conscious of keeping the discussion on topic as well as being willing to assume the facilitators' role to encourage and support each other. Compliments such as "Fantastic," "Good tips" and other praise abounded in students' replies.

While reflecting upon our design, we considered it essential to clearly articulate the object and rules of the discussion activity. The object and rules provided the structure and guidance for student learning. By moving to the side in the process of the discussion, we offered students opportunities to take the challenge in directing their own learning. Although we were not at the center of the stage, we monitored the discussion process closely and intervened when there was a need so students knew that we were there and available for help.

VI. RECOMMENDATIONS FOR FUTURE STUDIES

1. One of the purposes of design-based research is to advance theory that transcends a particular set of contexts [51]. In our research, we used the refined Activity System by Hung and Chen [28] as the design framework and achieved desired learning outcomes. To validate and confirm the refined Activity System, we recommend that the study be replicated in courses of different levels (e.g., graduates vs. undergraduates); with diverse subject matters (e.g., science vs. social sciences); and across various learning modes (e.g., distance learning, blended learning, and face-to-face learning).

2. Throughout the study, we observed that there was an interactive relationship between the rules we set and the online learning management system we used. The limitations imposed by the learning system compelled us to establish certain rules. For example, we required that students quoted their peers' messages because the system did not provide a convenient way to make references to other messages. We required students to acknowledge the messages they received because the system did not have an automatic acknowledgement function. We recommend that future studies focus on designing a new set of tools with expanded affordances in facilitating effective online discussions.

3. Traditionally, instructors largely assumed the role of facilitators in discussions. Online learning environments opened opportunities for students and faculty to share the role of facilitators. In this online discussion, spontaneous facilitation occurred among participants. Students were the ones who presented questions, kept the discussion focused, summarized the discussion, and confirmed understanding. Students played an essential role in successful online discussions, not only as participants, but also as facilitators. Some studies suggested that it was beneficial to assign facilitators' roles to students in online discussions [52, 53]. For instance, students were assigned the roles of group leaders [52], devil's advocates, eternal optimists and pessimists [54]. We recommend that comparative studies be conducted to

investigate types of student involvement as facilitators in terms of student motivation and cognitive presence in the online discussion.

VII. CONCLUSIONS

This design-based research allowed us to design an online discussion activity, implement it, and use the real classroom as a natural laboratory to observe, examine, and revise the design.

Our design embodied our hypothesis that the object and rules in an activity significantly influenced the success of the activity. Our empirical investigation validated our hypothesis and demonstrated that our design was effective in promoting cognitive presence in the online discussion.

The fundamental purpose of this design-based research is to improve teaching and learning in university courses with online technology. With the trend of integrating online technology into various learning settings to enhance the learning of diverse student populations, university instructors face great challenge in teaching in new online environments. It is our hope that this study provides a design framework that can be adapted, modified, and applied by practitioners for online learning activities in university courses.

VIII. ACKNOWLEDGEMENTS

The authors of this paper wish to thank all the students who participated in the online discussions reported in this study.

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INTERACTION IN ASYNCHRONOUS WEB-BASED LEARNING ENVIRONMENTS: STRATEGIES SUPPORTED BY EDUCATIONAL RESEARCH

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ABSTRACT

Because of the perceived advantages and the promotion of Web-based learning environments (WBLEs) by commercial interests as well as educational technologists, knowing how to develop and implement WBLEs will probably not be a choice, but a necessity for most educators and trainers in the future. However, many instructors still don't understand the most effective strategies for designing and implementing effective WBLEs even though numerous studies have demonstrated that the success or failure of online learning depends largely on the quality of interaction within those learning environments. Indeed, it has been said learning is impossible without meaningful cognitive interaction. However, this kind of interaction does not occur by itself. The primary goal of this paper is to explore the importance and characteristics of meaningful interaction in online learning, especially in asynchronous contexts. A secondary goal of this paper is to present several pragmatic strategies for improving meaningful interactions in WBLEs on the basis of a review of relevant research literature.

KEYWORDS

Asynchronous Online Interaction, Meaningful Interaction, Guiding Strategies, Web-Based Learning Environment

I. INTRODUCTION

Increasingly, the World Wide Web and other Internet technologies are becoming one of the main delivery systems for effective learning and teaching [1]. From elementary schools to universities, as well as at the corporate level, educators and trainers are using the World Wide Web and other Internet technologies to supplement classroom instruction with information specifically designed for instructional purposes as well as with information found in online resources originally intended for other reasons [2]. A few innovators are even using the Internet to deliver unique learning experiences unavailable through other means [3, 4]. The potential for change and innovation in the instructional delivery approaches is still expanding, and there is no reason to think that the growth of technological innovations will be slowed [4, 5].

Because of its perceived advantages by commercial interests as well as educational technologists, knowing how to develop and implement Web-based learning environments (WBLEs) probably will not be a choice for most educators and trainers in the future, but a necessity. Unfortunately, most instructors lack expertise in developing and facilitating WBLEs, and enhancing the quality of Web-based learning remains an important and necessary challenge.

II. ASYNCHRONOUS WEB-BASED LEARNING ENVIRONMENTS

One of the most widely used affordances of the Internet in WBLEs is asynchronous learning through means of online discussion forums where students can exchange ideas, discuss issues, and collaboratively search for solutions to problems. Instructional technologists, among others, promote the integration of online discussion forums and similar tools into WBLEs in the belief that students will use them to think and construct their own ideas, to compare their ideas with those of other people, and to reflect upon and reexamine their own understanding by reading and responding to peers' and instructors' postings [6]. Because of these perceived advantages, asynchronous text based technology is one of the most widely used tools across educational institutions around the world to support online learning [7]. Indeed, participating in and contributing to asynchronous discussions has become a required activity for many, if not most, college students today [8, 9].

However, the quality and effectiveness of supporting meaningful learning through Web-based learning and more specifically through asynchronous online discussions are still in doubt [10]. In a study involving 122 undergraduate students in the UK, Davies and Graff [11] found that greater participation in online discussions did not lead to better performance as measured by course grades. A recent review by Tallent-Runnels et al. [7] found that such asynchronous communication facilitated in-depth discussion, but no more than in traditional face-to-face class sessions. Just as instructors often struggle to engage students in classroom discussions, many online instructors find that they must require students to make a certain number of postings per week in online discussion forums, and as a result, students often post comments that have little relationship to higher-order thinking or learning just to meet the required number of postings [8]. Clearly, students who post to web-based discussion forums just to meet course requirements are unlikely to be engaged in meaningful interaction that stimulates learning.

III. MEANINGFUL INTERACTION

One of the key components of good teaching and learning, online or otherwise, is interaction. It has been argued that success or failure of online learning depends on the level of interaction that occurs [12, 13]. Milheim [14], after reviewing the literature on interaction within online learning, concluded that the consideration of interaction is the most important element in designing online learning. Trentin [15] also maintained that the quality of online learning depends on interaction, and he predicted that a 'third generation' of online technology would afford richer interaction and therefore increase the quality of learning. Beldarrain [16] describes how emerging technology tools, including wikis, blogs, podcasts, and social software applications, are being used to foster student interaction in online learning.

The nature of learning interaction can be defined in a variety of ways, for example, based upon the types of tasks which challenge participants within a course ranging from traditional academic tasks or real world authentic tasks [17, 18]. In addition, interaction is obviously influenced by the relationship between the teacher and the learners and the degree to which a course is teacher-centered or learner-centered [19]. The nature and level of involvement by participants in a specific instructional experience is also dependent on whether the participants are in face-to-face situation or at a distance using online technologies [12].

Within the context of online learning, several of the existing definitions of interaction are derived from communications theories and tend to be somewhat abstract. For example, Wagner [20] defined interaction as "the reciprocal events that require at least two objects and two actions" (p.8). The interactions occur when these two objects and events mutually influence each other. Moore's [21] definition of interaction is based upon a communication-based framework, defining the sender and receiver of three types of interaction: learner-content, learner-instructor, and learner-learner. Northrup [22] proposed five interaction purposes: to interact with content, to collaborate, to converse, to help monitor and regulate learning (intrapersonal interaction), and to support performance. Even though these definitions have been widely used as a basis of online interaction research, they do not consider the importance of learning which occurs during the interaction. When the interaction directly influences students' learning, we can say the interaction is meaningful [23, 24].

A more insightful approach to defining interaction in WBLEs may be derived from the learning theories underlying the development of particular learning environments. For example, behaviorists would emphasize the arrangements of stimuli, responses, and reinforcements that underlie interaction whereas social constructivists would seek to maximize the degree to which learning interactions enhance meaning making [25]. Therefore, depending on how learning is defined, the image of meaningful interaction is changed [24]. Recently many educators, including the authors, have come to see the value of social constructivism as a foundation for the design of more effective learning environments. This paper will accordingly follow the social constructivists' perspective. According to social constructivism as a learning theory, meaning is constructed in communities of practice through social interaction focused on solving shared problems, and thus social constructivists emphasize establishing dialogic interaction within the learning environment to promote student learning [26].

The definition of interaction provided by Vrasidas and McIsaac [27] follows the social constructivists' perspective. They defined "meaningful interaction" as "the intellectually stimulating exchange of ideas" [27]. Meaningful interaction is not just sharing personal opinions. Instead, the interaction must stimulate the learners' intellectual curiosity and directly influence their learning. This kind of meaningful interaction is an essential ingredient in any learning process. When students have engaging opportunities to interact with one another and their instructor, regardless of whether they are online or not, they can analyze, synthesize, and evaluate course content and use their new learning to construct shared meaning, solve ill-structured problems, and develop better understanding of their own knowledge [28]. Indeed, it has been said that learning online is impossible without meaningful interaction [29].

IV. THE CHARACTERISTICS OF ASYNCHRONOUS MEANINGFUL INTERACTION

At this time, asynchronous online courses are primarily dependent on written text as the communication medium. To have meaningful interaction within asynchronous learning environments requires that "others do respond; they argue against points, add to evolving ideas, answer questions, and offer alternative perspectives" [30]. According to studies of online learning, in comparison with oral interaction in a face-to-face classroom setting, asynchronous online written interaction focuses more on the topic, better supports the emergence of multiple perspectives, and encourages deeper reflection [30, 31, 32].

Ideally, through meaningful interaction, learners can advance their learning because of the unique benefits of an asynchronous WBLE such as the possibility of developing a better understanding of different perspectives, an ability to compare progress (and mistakes) with others or with set standards for interaction, opportunities for engaging in deeper reflection, and a richer exploration of the topic using Internet resources [9, 33]. Wilson and Stacey's [34] analysis of the effects of online interaction on

learning showed that group online interaction and sharing of resources helped students to become engaged in constructing new ideas and understanding other people's perspectives. In the context of asynchronous conferencing, students can negotiate meanings together, and, on the basis of the results of the negotiation, experience individual conceptual changes, a necessary process for effective learning [35].

Although successful, meaningful interaction can provide opportunities for reflection, exposure to multiple perspectives, sharing of ideas, and the discovery of what others are doing to learn [36], most present day Web-based learning environments do not live up to their potential for meaningful interaction [10, 37]. At least some of this failure can be attributed to technological weaknesses that tend to force students to put more of their cognitive load capacity into handling the user interface of a WBLE than into the learning process itself. In general, courses that include online discussions among learners in higher education through the use of commercial course management systems have not proven to be very satisfactory for learners or instructors [10]. Students are often overwhelmed and frustrated by the enormous amount of materials surfacing on the discussion bulletin board during the duration of a course. For example, Kirby [38] found that learners had difficulty tracking on-going discussions, and complained that it took several hours daily to keep up with the bulletin board. Hara and Kling [39] described the frustration students experienced with unfriendly technology and unreliable teachers in an online learning environment.

Once the novelty factor of online discussion abates, many students appear to lose their desire to write regular postings to a course discussion forum [40]. As a result, unless an instructor requires compulsory postings, learners usually fail to post their ideas on a regular basis, lose interest in the discussion, and the bulletin board gradually dies [41]. It won't surprise any experienced instructor that required postings are often shallow in substance [42]. Kanuka and Anderson [36] revealed that most of the interaction in their asynchronous online course was of a straightforward sharing and receiving information without meaningful dialog. When the students experienced information contradiction, there was a tendency to ignore it, and thus students failed to engage in the cognitive processes required to construct new knowledge. Similarly, Pena-Shaff, Martin and Gay [43] found that many of the messages posted on the discussion board looked more like monologues than dialogues, and there were also many postings in which students did not support their ideas with evidence. The so-called online discussion was only an opinion-sharing activity. In such situations, it is difficult to find evidence that meaningful interactions and learning have occurred. Kirschner, Strijbos, Kreijns, and Beers [44] summed up the problems with contemporary WBLEs as follows:

> *…these environments do not support such interactions in the same way that it occurs in face-to-face (i.e., time delay, lack of complete sensory contact, non-availability of off-task activities, etc.). The proximate result is often disgruntled or disappointed students and instructors, motivation that is quickly extinguished, poorly used environments, wasted time and money, and showcase environments that are often not much more than computer assisted page turning. The ultimate result is very similar to the first problem—no learning, because the students tend to give up. (pp. 47–48)*

Meaningful interaction does not occur by itself, especially in the context of teaching and learning online. Learners cannot be expected to know how to interact meaningfully in an online situation, even if all of the technological barriers are removed, without guidance. It should be clear that instructors who are striving to develop dynamic online environments and promote meaningful interaction within their online classes face many challenges [45, 46].

V. HOW TO PROMOTE MEANINGFUL INTERACTION

While it is evident that new technologies have expanded the potential for online interaction between students and instructors, meaningful interaction that actually contributes to student growth and learning requires careful planning on the part of the instructor. Social constructivists, drawing on the work of Vygotsky [47], have suggested that learning environments should involve 'guided interaction,' emphasizing the role of the instructor for providing the necessary guidance [48]. Facilitating interaction among students is central to the role of the online-learning instructor [49]. Instructors must provide the pedagogical foundation and structure to guide learners [50].

The level of interaction among online learners is influenced heavily by the structure of the course [27], which in turn is driven by the pedagogical strategies employed by the instructor [51, 52, 53]. According to a report from professors at the University of Illinois regarding teaching on the Internet (see http://www.vpaa.uillinois.edu/tid/report/), instructors should carefully organize student interactions, limit their lecturing, address student system familiarity, and intermittently summarize discussions and comments. Especially in asynchronous situations where there are few, if any, visual cues, the online instructor must be actively involved in monitoring and guiding the class to prevent it from being a simplistic opinion-sharing activity that fails to support learning. Regarding the need to guide meaningful interaction, Gallini and Barron [6] said,

> *Students need more specific guidelines and structures for interacting in asynchronous and synchronous environments, chat discussion groups, and even e-mail to become engaged in coherent group and meaningful interactions. (p.152)*

In a similar vein, Johnson and Aragon [9] wrote,

> *Two things are important to keep in mind. First, although the quantity of interactions is important, the quality of interaction is what should be stressed. Second, it is important that the instructor model the expected type of interaction by providing quality comments to the discussion itself. (p.40)*

Thus, one of instructors' more important tasks is to assist with strategies that facilitate meaningful use of the online educational environment for learning. Asynchronous online learning enriched with instructor guidance can help students increase their learning by guiding them to engage in a process of critical and reflective thinking, but this requires the design and use of effective facilitation strategies [31]. Research demonstrates clearly that instructors need to develop and apply better strategies that can foster meaningful interactions for learning on the WBLEs [9, 54, 55, 56].

A. Studies on Interaction Strategies in WBLEs

Although there is insufficient research that provides guiding strategies in online learning environments, some researchers have tried providing useful guidelines. Table 1 outlines the efforts.

Researchers	Research Supported Strategies
Bannan-Ritland,	Encouraging reflection
Bragg, and Collins [51]	Making a community of practitioners
	Applying project-based learning
Levin and Waugh [57]	Question answering and question asking

	Collaborating
	Student publishing
	Web weaving
	Project generating and coordinating
Lourdusamy, Khine, and Sipusic [58]	Using authentic cases
McIsaac, Blocher, Mahes, and Vrasidas [59]	Providing immediate feedback
	Encouraging the discussion
	Assigning pairs for moderating online discussion
	Using collaborative learning strategies (group project, group debate)
Northrup [22, 60]	Using innovative strategies including case studies, debates, role plays, and gaming.
	Requiring timely responses from peers and from instructor
	Providing an opportunity to self-monitor learners' own progress
Rossman [61]	Posting a weekly summary of the online discussion
	Monitoring the quality and regularity of learner postings
Vrasidas and McIsaac [27]	Training students to use emoticons, to use the conferencing system, and to employ appropriate etiquette
	Assigning student pairs with a mixed range of skills

Table 1. Research Related to Guiding Strategies

Through an in-depth literature review study, Bannan-Ritland et al., [51] provided a framework that integrates educational constructs (e.g., reflective components, social components and content components) with learning principles and instructional activities to identify effective instructional strategies for Web-based courses. They suggested following similar strategies in each educational construct:

- providing individual and small group reflection opportunities;
- asking for periodic self-evaluation to support reflective components;
- using a project based learning approach to content components;
- organizing social components such as a lounge or café to encourage a community of practitioners; and
- providing a clear and direct syllabus that permits assignment alternatives students can choose and ensures a match between objectives, strategies and assessment.

Levin and Waugh [57] investigated "teleapprenticeships" as interaction frameworks that support learning in the online context. Through a case comparison technique, five kinds of teaching apprenticeships were studied: question answering and asking, collaboration, student publishing, web-weaving, and project generation and coordination. They concluded that the integration of these apprenticeship frameworks into supportive institutional structures with new mediator roles is important for successful online learning.

Lourdusamy, Khine, and Sipusic [58] explored the impact of a tool that allows users to engage in collaborative discussion based on viewing authentic video footage (e.g., classroom teaching episodes) in teacher education. By rating students' participation and the quality of their comments, the authors

concluded that using authentic cases increases the quality and quantity of interaction in online learning situations. In addition, writing comments on authentic cases encouraged students to think and to see the relationship between theory and practice more clearly.

McIsaac, Blocher, Mahes, and Vrasidas [59] explored the perceived advantages and disadvantages of various types of interaction in an online classroom by analyzing several kinds of statistical data, message archives, and participant interviews. The feeling of isolation and the lack of immediate feedback were identified as main disadvantages. Based on the results, they concluded that instructors should contact students frequently and individually, show up online often to actively participate in the discussions, and use collaborative learning strategies in order to improve online interaction.

Northrup [22, 60] investigated several types of interactions that students perceived to be important for online learning through the administration of the Online Learning Interaction Inventory. The instrument focused on the four interaction attributes of content interaction, conversation and collaboration, intrapersonal/metacognitive skills, and need for support. As a result, the need for timely responses from peers and instructor, and the need for students to self-monitor their progress were identified as the most important factors in online learning. In addition, she found that students wanted to use some innovative strategies including case studies, debates, role-play, and playing games.

After analyzing the evaluation documents from 154 asynchronous online courses, Rossman [61] presented several tips for successful teaching in an online environment using an asynchronous discussion forum. Among them, providing specific and prompt feedback, modeling discussion processes, and providing specific course guidelines were representative.

Using an interpretivist approach, Vrasidas and McIsaac [27] examined the nature of interaction in an online course from both teacher and student perspectives to identify the factors influencing interaction. Data were collected through interviews, observations, and a review of online messages. As a result, four major factors influencing interaction were identified: structure, class size, feedback, and prior experience. Based on the research experience, the authors suggested requiring students to engage in discussion and collaborate on projects; training students early in the course to use emoticons, the conferencing system, and appropriate etiquette; and assigning students to collaborative pairs with a mixed range of skills.

B. Representative Strategies

On the basis of the review of the preceding studies, five representative strategies to increase the meaningful interaction in WBLEs were identified. They are modeling, dividing the class into small groups, giving appropriate feedback, encouraging reflection, and using authentic activities.

1. Modeling

First of all, instructors can model effective online interactions by demonstrating initiative, moderating discussions, and providing good examples of prior students' work. It is important to provide explicit guidelines about the level of participation expected in online contributions and then to exemplify this level in the instructor's interactions [62]. In particular, in an asynchronous situation, the instructor should model how to contribute to an online discussion, how to respond to other people's postings, and how to use emoticons and netiquette appropriately. An instructor can actively participate in the discussion, show higher-order thinking in postings, and acknowledge or constructively critique remarks that other students have posted. Instructors also may choose to provide prior student contributions as a means of modeling expectations, lowering student anxiety and increasing other students' self-efficacy [27, 63]. In this way,

instructors and peers serve as models for increasing participation and contribution within a new educational context [9].

Instructors can also model how to humanize the online learning environment [27, 63]. That is, they should play a key role in setting the emotional tone for their asynchronous online interactions [56]. Emotional tone can be shown through the use of emoticons made by combinations of punctuation marks [64]. Used appropriately, emoticons make it possible to express learners' attitudes toward the topic being communicated and to describe vivid and dynamic feelings [65, 66]. Most emoticons are composed of keyboard symbols. Some are simple and others are complex. The University of Illinois has provided a collection of emoticons to help their online learners (see http://www.ion.uillinois.edu/resources/tutorials/communication/index.asp). Figure 1 below illustrates some of the common emoticons used in online discussions.

Emoticon	Meaning	Emoticon	Meaning
:@ or :-@	Angry or screaming	>:-(	Angry, annoyed
|-I	Asleep	:/	Somewhat unhappy/discontent
:|	Serious	:o or :-o	Bored
:\/	Big mouth	:'(or :'-)	Crying/sad
:D or :-D	Grinning	{ }	Hug
:*) or :-*)	Kiss	:-D	Laughing
:X or :-X	Mute	:l or :-I	Not talking
:< or :-<	Sad	:> or:->	Sarcastic
B) or B-)	Shades	=:) or =:-)	Shocked
:Z or :-Z	Sleeping	:) or :-)	Smiling
:O or :-O	Surprised	:() or :-()	Talking

Figure 1. Common Emoticons Used in Online Discussions (by The University of Illinois)

After modeling, the instructor can scaffold the interaction by providing guidance and supporting materials [67]. Admitting and supporting the naturally occurring role of "lurker," i.e., someone who reads the messages of an interaction but does not contribute in online interactions [68], is a challenge not to be ignored. Novice learners can observe netiquette and ways of particular interaction by lurking [57]. In this way, the shy or "laid back" learners can vicariously experience meaningful interaction [67], and hopefully, later engage in these kinds of interactions themselves.

2. Dividing Class into Small Groups

Building collaborative components into an asynchronous online learning environment can foster interaction [49, 59]. Through a literature review, Tu and Corry [50] concluded "studies have shown that small-group instruction positively impacts student achievement, persistence, attitude, modeling, cognitive disequilibrium, cognitive development and social skills" (p.53).

Small groups with regular online interaction can increase the effectiveness of online learning [57, 59, 69]. To achieve these benefits of small groups, instructors' careful planning and oversight are required. The literature provides several suggestions: try to limit a group size to no more than 15 students with eight to ten being best [70]; set up student to student interaction through introductory activities and biographical posts [35, 56, 64, 71]; provide an 'ice-breaker' to introduce the students to each other and to the tutor, in

order to get the ball rolling and to humanize the process [14]; assign students to groups and assign roles for discussions [71, 72]; encourage commenting on each other's writing [72]; require each student or group to be a tutor or guru for a particular concept area [71]; and respect and highlight individual group members' abilities and contributions [50]. However it is accomplished, engaging small teams in online discussions enriches learning interaction and enhances the likelihood that individuals will be responsible contributors [50].

3. Giving Appropriate Feedback

Until students receive a reply or response on what they posted to an online discussion, they typically experience discomfort followed by frustration. Teacher and peer feedback are necessary for encouraging meaningful interaction [9, 22, 59, 60, 61]. An important job of the instructor is to interact with the learners to help bridge the gaps between the learners' understanding and the content. The instructor should also provide appropriate feedback concerning social interactions [48]. The social comments of the instructor and students often motivate other students to participate in online discussions and promote interest in each other's posting [63].

In WBLEs, giving appropriate feedback and providing positive affirmation of student work are essential components of interaction [56, 73]. Although it can be a daunting task with large numbers of students, online instructors can monitor student progress by reviewing chat room transcripts, emails, threaded discussions, and presentation spaces. Based on these reviews, instructors will have a better basis for providing feedback that will help learners engage in interactions that are more than superficial. Allan [74] describes an innovative approach for providing instructors with visualizations of instances of meaning construction and knowledge advancement within online discussion forums. Such a visual approach is especially important in situations where the number of students in a online discussion group is larger than recommended [70].

4. Encouraging Reflection

Vygotsky proposed two levels of interaction. One is on the interpersonal level between individuals, and the other is on the intrapersonal level within the individual [47]. Intrapersonal interaction means reflection. Reflection is "the learner's cognitive activity of looking back at relevant social interactions and their own or group learning activities and also looking forward in hopes of shaping and improving future learning interactions and activities" [48]. The instructor can encourage such reflection by asking students to keep a journal of what they do and experience, draw a concept map of their understanding of a process or idea, or maintain a database related to their new knowledge [22, 51, 60, 75]. Through the journaling process, learners can reflect on their participation in the interaction process. Of course, instructors should provide several good journal examples and demonstrate how to write a reflective journal.

Concept maps and database tools may also be helpful in supporting reflection. Drawing concept maps allows students to show the structure and interrelationships of the learning interactions. Building a database can serve a similar function. Other researchers have suggested their own strategies for encouraging reflection such as providing pause time between major interactions for recapping what has gone before, the use of debates, role-plays, online diaries, one-minute papers and modeling of reflective thinking [9, 76]. In addition, Johnson and Argon [9] recommended that posting an agenda of "the upcoming week serves as an advanced organizer and allows students to come to class better prepared for interaction" (p. 39). Through these pedagogical strategies, learners are able to reflect better and more actively participate in the online interaction process.

5. Using Authentic Activities

Perhaps the most powerful instructional strategy involves using case studies or critical incidents that engage students in applying learning to real world situations as discussion or project topics [22, 51, 60]. What people perceive, think, and do develops in a fundamentally social context regardless of whether it is the real world or a virtual one. Brown, Collins, and Duguid [77] stated that knowledge and skills cannot be separated from the context and community where they are used and that gaining knowledge always involves practical activity. Therefore learners should be engaged in authentic activities whenever feasible [18, 78, 79]. Lebow [80] describes authentic activity as "experiences of personal relevance that permit learners to practice skills in environments similar to those in which the skills will be used" (p. 9). Brown et al. [77] describe authentic activities as "ordinary practices of the culture" (p. 34), and Newmann and Wehlage [81] describe authentic activities as real world tasks that a person can expect to encounter in everyday life. Studies have shown that the structure of authentic activities in WBLEs can increase the quality of online interaction [9, 18, 58, 79]. Because authentic activities mirror real world tasks, they require students to cooperate, to communicate, to respect each other's views, and to use diverse skills to complete the task successfully [82]. Herrington and Oliver [17] describe a framework for designing authentic learning tasks for interactive learning environments.

Through the process of accomplishing authentic activities, meaningful interaction defined as exchanging intellectual ideas with one another is a necessity. In other words, collaborating students in an online learning environment would simply be unable to complete authentic tasks without meaningful interaction just as teams of people working in the real world are unable to complete authentic activities without substantive interaction. Research in Australia and elsewhere indicates the value of engaging in these authentic activities in Web-based learning environments. Herrington and Oliver [17], the foremost researchers in this area of study, concluded that "collaboration and problem solving in the authentic activities or projects provides interactivity in a far more authentic and context-specific manner than is possible with predetermined responses and feedback" (p.43). Table 2 below summarizes the guiding strategies and specific techniques mentioned above.

Guiding Strategies	Techniques
Modeling	Demonstrating initiative
	Providing good examples of prior students' work
	Providing explicit guidelines about the level of participation expected
	Showing how to respond to other people's posting
	Showing how to use emoticons and netiquette
	Admitting and supporting the role of lurker
Dividing class into small groups	Including introductory activities and biographical posts
	Assigning roles for discussion
	Requiring each student or group to be a tutor or guru for a particular concept area
	Posting upcoming agenda as an advanced organizer
Giving appropriate feedback	Monitoring students progress by reviewing threaded discussion and chat room
	Providing positive affirmation of student work
	Providing social comments
Encouraging reflection	Asking students to keep a journal

	Encouraging to draw a concept map
	Providing pause time between major interaction for recap
Using authentic activities	Designing and managing a course following guidelines for authentic activities

Table 2. Guiding Strategies and Specific Techniques

VI. DISCUSSION

Even though, as detailed above, the literature has provided a number of idealized instructional strategies for enhancing online interaction, they are not sufficient for college instructors or instructional designers in real practice. Instructors and instructional designers cannot be expected to know how to apply the idealized strategies to their own online courses without considerable support. Instructors may also have reservations as to whether the above strategies are truly effective in practice. Instructors and instructional designers need clearer guidelines, practical examples, and especially field-related information from other instructors regarding the use of these strategies [83]. By reviewing the successes and failures found in real cases, instructors are able to get a clearer picture of what meaningful interaction is and how meaningful interaction may be supported it in online courses. Important questions must be addressed:

- How can those strategies be designed and implemented in real online classes?
- How can learners be motivated to interact with one another in a reflective, engaged manner?
- How can instructors support meaningful interaction through feasible strategies that won't unrealistically increase their workload?
- What kinds of interaction are most meaningful for students' learning online in different fields of study, e.g., medical education or teacher preparation?

Many online instructors seek answers to these kinds of questions. Accordingly, more and better research that reveals the design strategies underlying successful asynchronous online learning cases and analyzes the reasons for the effectiveness of the strategies is needed.

As noted above, when interaction strategies are used appropriately, meaningful interaction can be increased. However, there is another issue to consider. How will we know when meaningful interaction has occurred? In another words, how can we really know whether interaction has affected learning, especially in Web-based learning environments? Woo and Reeves emphasized how interaction processes need to be analyzed and understood in terms of learning. They also introduced several analysis models based on content analysis and discourse analysis techniques [24]. In addition, other models such as the Quality Matters rubric (http://www.qualitymatters.org) can be used to evaluate the overall quality of online interaction and learning. However, even though these resources are good starting efforts to analyze and understand online interaction in terms of learning, they can be difficult for practitioners to apply in their own online courses. Instructors and instructional designers still need to find better methods or models to support and evaluate students' interaction and interaction strategies, especially in terms of meaningful interaction in day-to-day online classroom situations. Therefore, more research to develop a practical analysis model is needed. In this regard, "design research" methods are especially appropriate because of their twin purposes of solving real-world problems and identifying reusable design principles and enhanced theory [84]. It is also necessary to investigate the learners' and instructors' perceptions of interaction, interaction strategies, and analysis models in asynchronous web-based learning, and, on the basis of their perceptions, to develop more effective strategies for designing meaningful interaction activities in Web-based learning environments. By applying such research results, instructors and instructional designers may begin to have a clearer picture of successful online interaction and WBLEs

can be designed, implemented, evaluated, and redesigned for increased effectiveness.

VII. CONCLUSION

Although the World Wide Web and other Internet technologies are becoming so commonplace that participating in and contributing to asynchronous web-based learning have become required activities for many students, there is considerable room for improvement in the design and utilization of these interactive learning environments [1]. Despite its strong potential, many academics remain unconvinced of the effectiveness of asynchronous online learning. Therefore, increasing the quality of asynchronous Web-based learning remains an important and unmet challenge. One of the key components of good teaching and learning is interaction. Indeed, it can be argued that the success or failure of online learning depends on the level and quality of interaction. However, meaningful interaction that actually contributes to student growth and learning does not occur by itself. It requires careful planning on the part of the instructor and the implementation of multiple strategies for improving the interaction.

This paper has presented pragmatic strategies for improving meaningful interaction in WBLEs on the basis of a review of published research. Such strategies include modeling and scaffolding, dividing the class into small groups, giving appropriate feedback, encouraging intrapersonal interaction, and using authentic activities. However, for successful web-based interaction, further research is needed to show successful asynchronous online learning cases, to investigate the learners' and instructors' perceptions of interaction in web-based learning, and to develop more effective strategies for designing meaningful interaction activities in web-based learning environments.

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