**Abstract Title:** A First Attempt at Examining the Relationship between Student Success and Teachers' Participation in a Virtual Professional Learning Environment (PLE)

**MSP Project Name:** Institute for Chemistry Literacy through Computational Science (ICLCS)

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**120 word summary:**

In this presentation, authors examine innovative ways to understand if there is a relationship between student success and their teachers' yearlong participation in a technology-mediated professional learning environment (PLE). Initial data analyses indicate a strong relationship between teachers who have contributed to a high percentage of discussion threads during the year, and their students' achievement as measured by a standardized Chemistry test. These initial analyses find a linear relationship (p=.002) exists between students' (n=1422) learning gains and their teachers' (n=40) level of participation in the ICLCS professional learning environment. Authors will discuss how they are mining data in the PLE to better understand how online environments, such as the one being used in the ICLCS, can positively impact teachers and students.

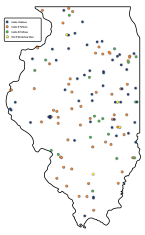
- Section 1: **Questions for dialogue at the MSP LNC**

  What are the indicators of teachers' participation in a virtual professional learning environment that are positively correlated with their students' learning gains as measured by a standardized test, and how are the indicators determined?

  Is there any relationship between teachers' participation in a virtual professional learning environment and their students' learning gains in the same academic year, and how can this relationship be quantified?

  What are the limitations of and next steps in this study?

- Section 2: **Conceptual framework**.



The ICLCS targets 124 rural high school teachers representing 119 individual school districts throughout the state of Illinois. Its vision is to create a *critical mass of highly effective high school science teachers for the 21st Century* through 350+ hours of extended and intensive professional development consisting of (1) science content mastery; (2) use of computational science research and teaching tools; (3) leadership training and mentoring; and (4) participation a virtual professional learning environment. The program uses a blended learning approach that consists of intensive, two-week residential

summer institutes backed by continuous online support and online courses each year for three years.

For purposes of determining student success, the ICLCS uses a standardized chemistry test produced by the American Chemical Society for high school students as one measurement of student success/achievement. Over the past 4 years teachers in all cohorts administered pre- and post-tests to their students. The program has collected 7,559-paired samples and continues to evaluate learning gains pre-and post-intervention. Cohort 2 teachers, who are represented here, were selected based upon their involvement in the second year course that emphasizes chemistry content and pedagogy. The authors examined 40 Cohort 2 teachers' 12-month participation in the PLE and their associated 1,422 students' pre- and post-test learning gains within the same period to determine if there is any relationship between teacher participation and student success.

The ICLCS program components are intricately connected year round by a virtual professional learning environment that connects participants, faculty, teacher-mentors, scientists, and UIUC students and is delivered via a license free learning management system (Moodle) that archives all communications and interactions among teachers and project staff. *All communications regardless of nature between all parties are done through the PLE.* We define the PLE to be a place where participants in the ICLCS can go to enhance their content knowledge, pedagogy, and use of computational tools, as well as gain access to peer, faculty, and scientist-mentors, vetted materials and computational resources. Participants are both producers and consumers of information and all communications that occur within the PLE are about teaching and learning. Over time, a robust and highly responsive network has emerged that has become the "lifeline" for many rural teachers, who are often the only science teacher in their school.

The theoretical underpinning of the online community's role in facilitating learning is the social nature of learning. According to Wenger and others (Wenger, 1998; Wenger, McDermott, & Snyder, 2002) engagement in communities of practice is a fundamental process through which persons learn. From the social constructivist perspective, learning is "a process of negotiation among the participants through dialogues or conversations" (Jonassen, Peck, & Wilson, 1999). In their seminal work on how people learn, Bransford, Brown and Cocking (1999) noted that current learning theories and learning research support the social nature of knowledge and learning, that is, making sense of the world and constructing knowledge through social interaction process. In a world of technological advancement, the affordance of internet-based communication has supported and expanded aspects of social learning – the reach of meaningful interactions have been extended beyond geographical and temporal limitations because of the technological means (Wenger, McDermott, & Snyder, 2002). As shown in our first publication (Murray, Henry, & Hogrrebe, 2009), the overall ICLCS intervention demonstrated significant learning gains ($p<.001$) among students of the participating teachers in comparison to a comparable non-participant group after one year of implementation. In the present analysis, the focus is on whether or not teachers' PLE participation impacts student success as we have defined it.

- Section 3: **Explanatory framework**.

*3.1 Claims examined in the work*

The authors examined 40 Cohort 2 teachers' 12-month participation in the PLE and their associated 1,422 students' pre- and post-test learning gains within the same period to determine if there is any relationship between the level of teacher participation in the PLE and their student gains. Using correlational analyses, the authors attempted to identify a linear model that would provide a reasonably reliable link between students' learning gains and teacher activity indicators, which are significantly correlated with the outcome variable. Upon examination of the link between teachers' levels of contribution to the learning environment and their associated student learning gains, analyzes show that there exists a linear relationship (p=.002) between teachers' yearlong participation intensity in the PLE and their students' learning gains. *While these are only preliminary results*, they do mirror self-reported survey findings, as well as accumulated anecdotal reports from teachers and program staff.

*3.2 Research design, data collection and analysis*

Teachers in the ICLCS are selected through a rigorous application process and represent small K12 districts across the state of Illinois. After the summer institute, during the academic year 2009-2010, 40 participating teachers in Cohort 2 were actively involved in ICLCS components via their continuous engagement in the virtual professional learning environment. The PLE is organized into several units under sections called portals. Portals are categorized by topics, including, e.g. chemistry content, teaching and learning, resource sharing, and technology assistance. Other portals are grouped by their functionality, e.g. summer institute, team module development, leadership, etc.

All of the teachers' online activities are recorded and archived in a log file, which is automatically created and maintained by the server hosting the ICLCS site. Therefore, various types of online user actions are recorded, including number of logins, contributions to a new discussion thread,[1] responding to an existing post, reading/viewing posts, uploading documents, chatting with others, etc. From this data set, more than 20 possible participation indicators were examined. *For the purpose of this exploratory study, **two** user actions in the log (adding posts and viewing posts) were used to compute the four participation indicators having the highest correlation to student learning gains.*

Described below are the four selected indicators and how they were computed:

| | |
|---|---|
| PcThreadPosted | The number of discussion threads to which a teacher contributes one or more posts *divided* by total number of discussion threads in 2009-10. |
| PostViews | The total number of times a teacher viewed any posts in 2009-10. |
| PctThreadViews | A teacher's number of distinct discussion threads viewed[2] *divided* by the total number of threads in 2009-10. |
| PctSigThreadViews | A teacher's number of significant posts[3] viewed *divided* by the total number of significant posts of the year 2009-10. |

[1] A discussion thread includes the initial posting and all the direct and indirect replies to that initial posting.
[2] If any given teacher views a discussion thread more than once, that teacher's number of *distinct threads viewed* for that particular thread is counted as one.
[3] Significant posts are the posts that contain one or more Chemistry domain keywords such as acid, equilibrium.

To measure the correlation between teachers' participation and student success, Pearson correlation procedures were carried out for the above four participation indicators using SPSS®[4]. In Table 1, the results showed a highly significant (p=.001) and near high correlation strength (r= .449 to .49) between all four indicators and student learning gains. Since the 4 correlational coefficient values are close, we plan to further investigate any underlying factor that is measured by all the independent variables.

**Table 1. The Correlation Chart between Teacher Participation Indicators and Student Learning Gain:**

| **Pearson Correlation** | **S_Gain (Student learning gain)** |
|---|---|
| PctThreadPosted | .490** |
| PostViews | .464** |
| PctThreadViews | .455** |
| PctSigThreadViews | .449** |

** Statistically significant at .001 level

A series of bivariate regression analyses were then conducted using SPSS to identify a linear model that would provide a reasonably reliable prediction of students' learning gains based on teacher participation indicators. The following independent variables were included in the analysis: PctThreadPosted, PostViews, PctThreadViews, and PctSigThreadViews.

The results found that among those studied, the model including the variable [PctThreadPosted] best accounts for the variance in the student learning gains on the ACS tests. In other words, the more a specific teacher posts on discussion threads in the PLE, the more likely his/her students will receive benefits of their teacher's participation. However, it is important to note that the result of this correlational study does not imply a causal relationship between the independent and outcome variable.

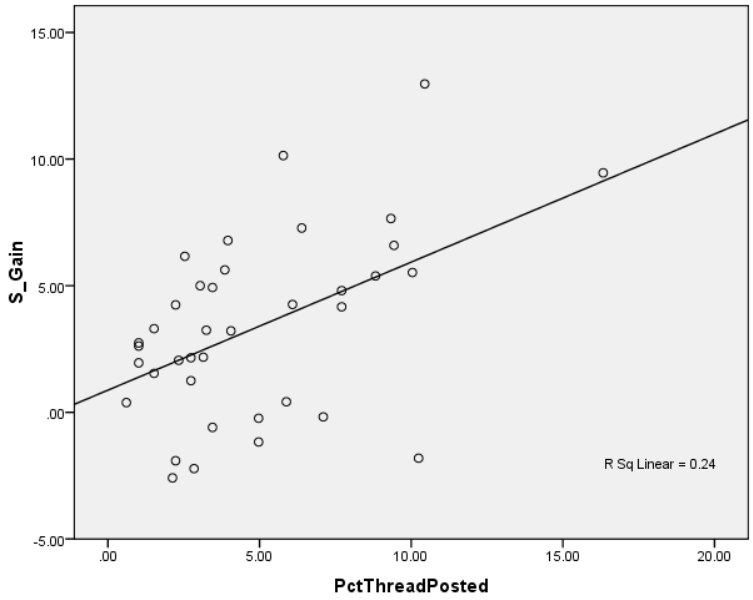
The regression analysis on the variable [PctThreadPosted] generates the following linear model of student learning gains:

$$S\_Gain = .876 + .506 * PctThreadPosted$$

The above linear regression equation (or line of best fit) is depicted graphically in Figure 1. This linear model is statistically significant ($F_{1,36} = 11.35$, $p = .002$). The reported adjusted R square indicates that the student learning gain model accounts for 21.9% of variance in students' learning gains in the ACS tests in year 2009-2010.

[4] SPSS Data Mining and Statistical Analysis Software; see www.spss.com

**Figure 1. XY Scatter Plot Showing the Regression Line Predicting Students' Score Gains**




**Key insights (retrospective for veteran projects, prospective for newer projects) that have value for the Learning Network**

The use of virtual learning communities to facilitate learning in various teacher professional development programs has increased in the recent decade (Lindberg & Olofsson, 2010). Yet, researchers have not fully understood the role a teacher's PLE participation plays in impacting student learning. The authors are attempting to examine what, if any, links exist between teacher participation and their student success. Our findings do not imply causality, yet they will help the ICLCS and other MSP projects refine future studies to more clearly understand these links. While there is more work to be done in determining how PLE participation can positively influence student learning, our analyses and qualitative data gathered from teacher participants in the ICLCS, give evidence that a well-designed, robust, and active virtual professional learning environment can extend professional development past in-person sessions through meaningful access to colleagues, experts, and high quality resources, thus impacting teachers' professional growth. The authors believe that the ICLCS PLE has greatly contributed to the overall success of the professional development. For the geographically isolated rural teacher, it has been stated "it is the lifeblood of the program."

We wish to thank I-STEM and our external evaluators for the test data.

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MOODLE. Moodle is an Open Source Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). http://moodle.org.

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