Title: Summary of information on essential questions/inquiry-based learning and technology

Date: October 2014

Question: >> Could you provide information on using essential questions/inquiry-based learning and technology in the classroom?

Response:

This memo includes articles on the use of essential questions/inquiry-based learning and technology in the classroom.

- Citations include a link to a free online version, when available.
- Citations are accompanied by an abstract, excerpt, or summary written by the author or publisher of the document.

We have not done an evaluation of the rigor of these resources, but provide them for your information only.

References

Buckner, E., & Kim, P. (2014). Integrating technology and pedagogy for inquiry-based learning: The Stanford mobile inquiry-based learning environment (SMILE). *Prospects: Quarterly Review of Comparative Education, 44*(1), 99–118. Retrieved on September 26, 2014, from http://elizabethbuckner.files.wordpress.com/2012/01/10-1007_s11125-013-9269-7.pdf

Abstract: Despite the long-standing interest in educational technology reforms, many researchers have found that it is difficult to incorporate advanced information and communications technologies (ICT) in classrooms. Many ICT projects, particularly in the developing world, are limited by the lack of integration between pedagogy and technology. This article presents a framework for integrating ICT technology and inquiry-based pedagogies in classroom settings: the Stanford Mobile Inquiry-based Learning Environment (SMILE). It then outlines findings from a series of studies that tested SMILE's effectiveness in various country contexts. SMILE successfully spurs student questioning and changes student-teacher dynamics in class. On the other hand, school and country contexts influence students' initial abilities to form deep inquiries, and SMILE is more difficult to implement in areas where rote memorization pedagogies are typical. The authors advocate further research on the effect of long-term interventions.

Hakverdi-Can, M., & Sonmez, D. (2012). Learning how to design a technology supported inquiry-based learning environment. *Science Education International*, *23*(4), 338–352. Retrieved on September 26, 2014, from http://files.eric.ed.gov/fulltext/EJ1001628.pdf

Abstract: This paper describes a study focusing on pre-service teachers' experience of learning how to design a technology supported inquiry-based learning environment using the Internet. As part of their elective course, pre-service science teachers were asked to develop a WebQuest environment targeting middle school students. A WebQuest is an inquiry-oriented lesson format in which most or all the information with which learners work comes from the Internet. The study examined participants' experiences and reflections. Qualitative research methodology was used to analyze the collected data. The findings of this study showed that WebQuest is an effective teaching tool and that participating pre-service teachers had a positive experience of developing it as part of their study. This experience positively affected their content knowledge and understanding of technology-supported inquiry learning environments, allowing them to learn how to create an inquiry-based and technology-supported lesson. All participants indicated their intention to use WebQuest in their future teaching practices.

Hester, J. L., Owens, R. F., & Teale, W. H. (2002). Where do you want to go today? Inquiry-based learning and technology integration. *The Reading Journal, 55*(7), 616–625.

Abstract: Describes two projects that incorporated inquiry into urban educational settings. Offers practical considerations for employing technology-enhanced inquiry in the classroom and discusses broader theoretical issues related to the contribution of technology to literacy learning and motivation when students ask their own significant learning questions, which, in the long run, lead to more questions.

Hong, J., Hwang, M., Liu, M., Ho, H., & Chen, Y. (2014). Using a "prediction–observation–explanation" inquiry model to enhance student interest and intention to continue science learning predicted by their internet cognitive failure. *Computers & Education*, *72*, 110–120.

Abstract: The development of information technology, such as iPad applications, facilitates the implementation of constructivist teaching methods. Thus, the present study developed a "prediction–observation–explanation" (POE) inquiry-based learning mode to teach science concepts using the iPad2. The study used the "attention-to-affect" model with a self-report measure to determine the antecedent factor—Internet cognitive failure—related to learning interest based on students' continuance intentions to practice POE inquiry using the iPad2. A total of 96 elementary 6th grade students participated in the study and completed the questionnaires, of which 81 effective questionnaires were validated for the confirmatory factor analysis with structural equation modeling. The results of this study indicated that Internet cognitive failure was negatively associated with three types of learning interest as indicated by high levels of liking, enjoyment, and engagement. On the other hand, three types of learning interest were positively correlated to continuance learning through iPad2 interactions. The results suggested that the POE mode of inquiry is suitable for implementing at an intelligent mobile device to enhance young students' interest and continuance intentions with respect to the learning of science.

Crippen, K. J., & Archambault, L. (2012). Scaffolded inquiry-based instruction with technology: A signature pedagogy for STEM Education. *Computers in the Schools*, *29*(1/2), 157–173.

Abstract: Inquiry-based instruction has become a hallmark of science education and increasingly of integrated content areas, including science, technology, engineering, and mathematics (STEM) education. Because inquiry-based instruction very clearly contains surface, deep, and implicit structures as well as engages students to think and act like scientists, it is considered a signature

pedagogy of science education. In this article the authors discuss the nature of scaffolded inquiry-based instruction and how it can be applied to the use of emerging technologies, such as data mashups and cloud computing, so that students not only learn the content of STEM, but can also begin answering the critical socioscientific questions that face the modern era.

Lara-Alecio, R., Tong, F., Irby, B. J., Guerrero, C., Huerta, M., & Fan, Y. (2012). The effect of an instructional intervention on middle school English learners' science and English reading achievement. *Journal of Research in Science Teaching, 49*(8), 987–1011.

Abstract: This study examined the effect of a quasi-experimental project on fifth grade English learners' achievement in state-mandated standards-based science and English reading assessment. A total of 166 treatment students and 80 comparison students from four randomized intermediate schools participated in the current project. The intervention consisted of ongoing professional development and specific instructional science lessons with inquiry-based learning, direct and explicit vocabulary instruction, integration of reading and writing, and enrichment components including integration of technology, take-home science activities, and university scientists mentoring. Results suggested a significant and positive intervention effect in favor of the treatment students as reflected in higher performance in district-wide curriculum-based tests of science and reading and standardized tests of oral reading fluency.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., Fishman, B., Soloway, E., Geier, R., & Tal, R. (2004). Inquiry-based science in the middle grades: Assessment of learning in urban systemic reform. *Journal of Research in Science Teaching 41*, 1063–1080. Retrieved on September 25, 2014, from https://crippen.education.ufl.edu/projects/PASS/Summer_2005/JRST_41_10_1063.pdf

Abstract: Science education standards established by the American Association for the Advancement of Science (AAAS) and the National Research Council (NRC) urge less emphasis on memorizing scientific facts and more emphasis on students investigating the everyday world and developing deep understanding from their inquiries. These approaches to instruction challenge teachers and students, particularly urban students who often have additional challenges related to poverty. We report data on student learning spanning 3 years from a science education reform collaboration with the Detroit Public Schools. Data were collected from nearly 8,000 students who participated in inquiry-based and technology-infused curriculum units that were collaboratively developed by district personnel and staff from the University of Michigan as part of a larger, district-wide systemic reform effort in science education. The results show statistically significant increases on curriculum-based test scores for each year of participation. Moreover, the strength of the effects grew over the years, as evidenced by increasing effect size estimates across the years. The findings indicate that students who historically are low achievers in science can succeed in standards-based, inquiry science when curriculum is carefully developed and aligned with professional development and district policies. Additional longitudinal research on the development of student understanding over multiple inquiry projects, the progress of teacher enactment over time, and the effect of changes in the policy and administrative environment would further contribute to the intellectual and practical tools necessary to implement meaningful standards-based systemic reform in science.

Obenchain, K. M., Orr, A., & Davis, S. H. (2011). The past as a puzzle: How essential questions can piece together a meaningful investigation of history. *Social Studies*, *102*(5), 190–99.

Abstract: This article details a professional development program focused on the use of essential questions in reframing U.S. history learning experiences in elementary, middle, and high schools.

Teachers identified four problems in designing and teaching engaging, relevant, and challenging U.S. history lessons. Each problem was addressed through the teachers' use of essential questions.

Methods

Keywords and Search Strings Used in the Search

"Essential questions" OR "use of essential questions" AND "technology"; "inquiry-based learning" AND "technology"; "inquiry-based learning"

Search of Databases

EBSCO Host, Google, Google Scholar, and PsycARTICLES

Criteria for Inclusion

In general, when REL West staff review resources, we consider—among other things—four factors:

- **Date of the Publication:** The most current information is included, except in the case of nationally known seminal resources.
- **Source and Funder of the Report/Study/Brief/Article:** Priority is given to IES, nationally funded, and certain other vetted sources known for strict attention to research protocols.
- **Methodology:** Sources include randomized controlled trial studies, surveys, self-assessments, literature reviews, and policy briefs. Priority for inclusion generally is given to randomized controlled trial study findings, but the reader should note at least the following factors when basing decisions on these resources: numbers of participants (Just a few? Thousands?); selection (Did the participants volunteer for the study or were they chosen?); representation (Were findings generalized from a homogeneous or a diverse pool of participants? Was the study sample representative of the population as a whole?).
- **Existing Knowledge Base:** Although we strive to include vetted resources, there are times when the research base is limited or nonexistent. In these cases, we have included the best resources we could find, which may include newspaper articles, interviews with content specialists, organization websites, and other sources.

This memorandum is one in a series of quick-turnaround responses to specific questions posed by educators and policymakers in the Western region (Arizona, California, Nevada, Utah), which is served by the Regional Educational Laboratory West (REL West) at WestEd. This memorandum was prepared by REL West under a contract with the U.S. Department of Education's Institute of Education Sciences (IES), Contract ED-IES-12-C-0002, administered by WestEd. Its content does not necessarily reflect the views or policies of IES or the U.S. Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.