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Title: BioBridge Professional Development: Bringing Innovative Science into the Classroom

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Abstract Body

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Background / Context:

The BioBridge Professional Development model was created to bring current and relevant science into the high school classroom. When designing and implementing this intervention, we addressed the following educational needs and practices:

1. The importance of focusing on *specific science content* (Cohen & Hill, 1998) in order to increase the depth of teachers' subject-area knowledge and address teacher desire for exposure to current research findings and processes. By placing university researchers in direct contact with teachers and utilizing these researchers' ongoing lab activity as the basis for co-designing innovative classroom/lab activities, we sought to increase teacher interest and engagement.
2. The value of *active learning*, that is, of obtaining adequate opportunity to practice newly acquired skill sets, determining the best application of those skills, and engaging in meaningful discussion concerning how best to achieve successful classroom implementation (Loucks-Horsley et al., 1990; Liberman, 1996). By involving teachers in working teams with peers during the learning phases of BioBridge activities, and by subsequently involving them with small teams of their own students for hands-on implementation practice, we encouraged the practice of working together in active situations that facilitate learning through practice and discussion.
3. The power of teacher *collective participation* through forming professional development groups working within the same school or disciplines to improve knowledge, skills, and classroom practice (Talbert & McLaughlin, 1993). By engaging in joint professional development, teachers were able to integrate what they learned with other aspects of their instructional context and contribute to a shared professional culture that facilitates debate and improved understanding that underpins teachers' capacity to grow (Ball, 1996).
4. The need for *coherence*, that is, for a logical and systematic connection to broader curricula or to local/state/national standards. Professional development activities that bear little or no connection to other instructional topics have been shown to be less effective than those that fit within a broader context and contribute to teachers' wider opportunities for learning and ongoing development. If a coherent set of goals are involved, we can facilitate teachers' efforts to improve teaching practice (Grant, Peterson, & Shojgreen-Downer, 1996).

Purpose / Objective / Research Question / Focus of Study:

The purpose of this intervention was to connect teachers with relevant science and to create innovative, hands-on activities that engage students, with the goal of increasing student interest in STEM careers. To this end, we created and implemented a professional development model based on current scientific research at the University of California, San Diego (UCSD). Project research objectives were: (1) to determine whether the basic BioBridge Professional Development (PD) model is transportable across districts; (2) to determine if the model's fundamental template is adaptable across a range of science subject areas; (3) to determine if the model is seen as useful by teachers in terms of their training outcomes; and (4) to discover whether teacher-scientist teams can collaboratively adapt lab-based research into discovery-oriented learning activities suitable for instructional use in authentic high school classrooms. The proposed poster will share methods used to observe teachers' classroom implementation of the materials and pedagogy from the PD, with a particular focus on the ways that these data have been used to establish a fidelity of implementation score. A secondary purpose of the poster will be to describe district-level End of Course Exam data that have been analyzed in relation to FI scores to understand whether and how the fidelity metric relates to student outcomes.

Setting:

The program serves three school districts, including 38 high schools, from diverse ethnic and socio-economic populations in both urban and suburban locations. More than 300 teachers and 90,000 students have participated in the program over the course of three years

Population / Participants / Subjects:

Sweetwater Union High School District (SUHSD), adjoining the international border with Mexico in south San Diego County, is California's largest secondary district with 42,000 middle/high school students. 85% of these are ethnic minorities with over 25% English language learners (ELL), and 50% speaking a non-English language at home. San Diego Unified School District (SDUSD), California's second largest district and the eighth largest [urban] nationally, encompasses San Diego's economically disadvantaged inner-city area and serves more than 135,000 K-12 students. Over 28% of its diverse ethnic populations are English language learners (ELL) with some 60 languages primary used at home. Oceanside Unified School District (OUSD) serves many semi-transient military dependents from the immediately adjoining Marine Training Base at Camp Pendleton, as well as from various associated U.S. Navy facilities. District enrollment is just over 21,000 with 27% of students being English language learners (ELL).

Intervention / Program / Practice:

The BioBridge PD model, which involves bringing teachers and students to the UCSD campus, is based on a four-phase approach designed to progressively transition and support teachers. The model progresses from an initial knowledge exposure and acquisition phase, in which small groups of teachers are introduced to a specific content-based lab activity as "students," through full-scale independent authentic classroom/lab implementation. BioBridge creates a "scaffolding" approach by adapting emerging research technologies for classroom use, then progressively training and assisting teachers with their implementation, underpinned by pedagogically effective strategies. All new activities are structured to directly support student mastery of one or more state/district standards. The teacher professional development activities developed in the three years of the program are designed to reinvigorate high school science teachers through contributing to their growing knowledge of evolving scientific discovery and of research lab techniques.

Research Design:

Formative field test with self-selected treatment and comparison group.

Data Collection and Analysis:

To document the full implementation of science activities in the classroom, classroom observations were conducted for 65 teachers as they implemented the program's science labs with students. Thirteen criteria were used to determine the fidelity of each teacher's implementation; teachers who met 11 or more of these criteria during implementation were considered to be at fidelity. In addition, a secondary analysis of district-level test score data was made possible through an agreement with one of the school districts. To analyze the impact of the program on student knowledge, a series of hierarchical linear models (HLMs) was conducted. The final model consisted of a two-level adjusted treatment effects model to investigate the differences between program and non-program students' End of Course Exam scores.

Findings / Results:

Results from the fidelity of implementation analysis indicated wide variability in the extent to which teachers implemented the program as intended.

- At least two-thirds of the teachers observed met 10 of the 13 criteria.
- Three of the criteria were met by half of the teachers, or fewer.
- Only one criterion was observed in 100% of classroom implementations.

Results indicated that students performed relatively poorly (averaging below 60% on topic-related assessments) when exposed to only one hands-on BioBridge activity. However, student test scores increased in all outcome areas measured when exposed to multiple activities. Further exploration of the data indicated that the positive impact of the program on test scores was only found for students of Master's level teachers.

The BioBridge team has also anecdotally observed that the consistency of BioBridge lab implementation is limited by increased class sizes, budget constraints/teacher layoffs, and lack of support for teachers in the classroom.

Conclusions:

The results of the fidelity of implementation assessment indicate that the BioBridge program has not yet reached its goal of having 75% of teachers implement at fidelity. Changes have been made to more clearly define the fidelity of implementation measures and how that translates into the classroom implementations. The results of student test score analysis are encouraging, but it is clear that additional training and/or support must be provided to teachers in order to achieve broad student impact. The BioBridge team is currently exploring program modifications that will increase the success of Bachelor's-level teachers. One approach under consideration is offering differentiated training for Bachelor's and Master's-level teachers. Another possibility is to create communities of practice within schools that cluster Master's-level with Bachelor's-level teachers.

Though the results from the individual fidelity of implementation and student test score analyses have each yielded meaningful data that were used to make program improvements, the challenges associated with collecting these data are not insignificant. Teacher communication has been the primary challenge associated with the collection of fidelity of implementation data. This lack of certainty has resulted in missed opportunities to collect fidelity of implementation data and in incomplete observations.

Communication has also been a challenge in relation to the test score analysis. Though the district partner involved with this project has been generous in sharing End of Course Exam data, there have been challenges to overcome with this process as well. In an effort to continue to improve their exam process, the district has made a number of changes over the past two years. The BioBridge team was not consulted as part of this process, and some of these changes have impacted the project. The research team is currently working with Data Director to obtain the data in a usable format. Future collaborations with the district will also include a monthly call with the district contact to learn about upcoming meetings that might relate to the collection of End of Course Exam data. It is the hope that this strategy will result in a heightened consideration of the research team when making district-level decisions about testing procedures.

The BioBridge team is working with the evaluation team to collect data on teacher limitations to consistent BioBridge lab implementations. We anticipate that these data will generate a better understanding of the repercussions of budgetary constraints for the school districts, and how to better support teachers in the current economic climate.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures
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