

## Overview

This memo covers external evaluation services provided to the Math Machines project for the period May 15, 2011 through June 30, 2012. The document summarizes the final evaluation activities and results. There are three sections: (1) Activities Summary, (2) Results Summary and (3) Actions to Consider.

## Activities Summary

### Activities Accomplished For the Period (May 2011-June 2012)

The focus for this year was to compare the effectiveness of the condensed workshop format (7 contact hours<sup>1</sup>) with a prior time intensive format (42 contact hours). Participants for the condensed format workshop were community college faculty and high school faculty for the time intensive format.

1. Review of the grant proposal and prior survey materials for the purpose of determining the constructs key to the final stages of external evaluation for this project.
2. Email communication.
3. Conference calls, May 15, 2011; February 15, 2012; and May 30, 2012.
4. *Workshop Follow-up e-Survey* draft and implementation for second round.
5. Analysis and interpretation of time intensive workshop format results compared to those for the condensed.
6. Preparation of PowerPoint of results
7. Final Evaluation Status Update

### Construction of Project Evaluation Approach

Efforts for this period focused on working with the project team to complete the comparison of the value/impact contributed by the project's two format workshops for ATE stakeholders. The project team will take responsibility for process monitoring and an internal evaluation role. Phillips Wyatt Knowlton, Inc. has responsibility for external evaluation and also serves a technical assistance role for the project.

---

<sup>1</sup> The condensed workshop was offered in the context of a broader professional development environment; therefore can claim contribution to results but is not the sole provider of content. The workshops were offered as part of the on-going professional development commitment at each participating community college. In addition, participants also attended two sessions on this topic that were components of a two-week course also offered by an NSF-ATE grant.

Several email communications and three telephone conference calls with the project team provided the background/context for shaping the final year evaluation design<sup>2</sup>.

## Summary of Project Progress to Date

As part of the design process for the external evaluation of *Math with Machines*, we had the opportunity to review the project's grant proposal, progress reports, prior workshop feedback tools/data as well as the draft student assessment tool. We also facilitated two in-depth conversations with the project PIs about their work to date and the strengths/challenges encountered by staff thus far. Based on this evidence, we believe that the project and its staff are:

1. Engaged in vital work to bolster the problem solving/critical thinking skills of community college and high school mathematics faculty as well as the students they serve.
2. Fully prepared to develop and field test the type of innovative student assessment tool needed to capture evidence of higher order thinking skills and more effective problem solving strategies among community college and high school mathematics students exposed to their intervention.
3. Making steady progress toward the achievement of the goals established in the grant proposal as well as successfully addressing logistic/scheduling issues related to the delivery of planned professional development opportunities.
4. Very well positioned to leverage the learning gained through their prior NSF-ATE grant in ways that will ultimately spread the *use of technology coupled with small group experiences* to increase the quality of learning for community college and high school faculty/students.

## Activities Planned for the Period (July, 2012-June 30, 2013)

1. No external evaluation activities are planned for the extension period.
2. Routine email communication and conference calls, if needed, to support dissemination of the findings.

## Results Summary

**Overall, the condensed format workshop—delivered in the context of broader professional development activities—was shown to be as effective as the time intensive format on nearly all outcomes assessed for both faculty and students** (see Power Point, *Math Machines & Algebraic Thinking Follow-up Survey*, 7/25/12 for full details).

Significant gains were found for both formats in the areas of how faculty design and deliver instruction that contributes to: (1) **stronger basic and advanced problem-solving skills** and (2) **greater STEM engagement and interest among students**.

---

<sup>2</sup> See the *Evaluation Plan* for details of the evaluation design and implementation.

Faculty readily adopted the instructional strategies promoted by the workshops equally well for both formats and for both participant types. Securing the time to set up and guide students in use of the equipment was a significant challenge noted by many participants from both formats. Assessment was an additional challenge shared by participants from both formats. Findings presented are for the condensed format workshops offered under the current grant.

## Faculty

- 50% or more indicate persistence of strong positive attitudes, knowledge and skill in use of problem solving strategies, proficiency in experimenting with electronics and beliefs in the value of real world classroom applications. *Faculty commented on the value contributed by the workshops to their classroom practice.*
- 50% or more noted increased opportunities for students to explore math functions in small groups, and to experience the relevance of math career pathways. *Faculty noted that the hands-on, small group approach promoted by the project helps students learn more effectively (deeper and tangible).*
- 50% or more reported increased collaboration and exchange with colleagues related to STEM disciplines and use of Math Machines.
- 50% have used Math Machines stations for demonstration and/or small group work in the 6-9 months since participation in the workshops. *Time for set-up and planning, as well as number of stations are noted as the major constraints to broader classroom use. Uses reported were primarily to demonstrate or model the relationships among linear functions.*
- Less than 50% of workshop participants currently use assessment to inform instruction; however, assessment was not a major emphasis of the workshop content.

## Students

- 50% or more report that their students have stronger basic and advanced problem solving skills after exposure to the instructional strategies introduced at the workshops. *Faculty mentioned that students enjoyed learning through experimentation and hypothesis testing.*
- 50% or more indicate higher levels of STEM engagement, enjoyment, math career relevance and time on task among their students after exposure to the instructional strategies introduced at the workshops. *Faculty mentioned that students have developed better understanding of functions and the connection between math and physics.*
- Nearly all of the faculty that were able to use the stations with their students shared that their students have stronger ability to apply math functions and proficiency experimenting with electronics.

## Actions to Consider

Given the effectiveness of the workshop(s) in encouraging community college and high school faculty to implement hand-on, small group STEM learning experiences that promote the development of higher order thinking skills/problem solving, it will be important to **communicate the results of the evaluation** to the ATE community and other allied audiences.

Provide some **follow-up support, to the extent possible**, for those workshop participants that had not yet had opportunity to use the equipment in their classrooms. Also, nearly all participants made special mention of having access to additional activities and information. To the extent possible, communicate the availability of current resources on the project website.