

Opening Opportunities through Math Board Games: Collaboration between Schools and a Teacher Education Program

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Abstract

As the recession that began in 2008 continues to impact schools at every level, collaboration among educational entities is a matter of survival because public schools and universities are strapped for resources. Therefore, they must reach out and combine their efforts to provide needed services at a minimum cost. A natural partnership exists between public schools and institutions of higher learning that provide the lifeline to schools via their teacher preparation programs. When properly coordinated, collaboration between a college of education and public schools can benefit everyone involved. This article outlines the collaborative efforts between a university and a school district focusing on a math program, the eX-Games Project, a community-based project that brings together pre-service and in-service teachers, graduate students, and K-8th grade students to develop an understanding of various mathematical concepts through board games.

Introduction

Collaborations between institutions of higher learning and school districts have been extensively documented and researched (Cavallo, Ferreira, & Roberts, 2005; Curcio, Artzt, & Porter, 2005; Jones, Stallings, & Malone, 2004; Rollins-Searcy, Stevenson, & Taylor, 2004). As early as 1982, Zenger and Zenger outlined a 10-step process for articulating programs between K-12 schools and universities to ensure that both parties benefit from the partnership. According to Rollins-Searcy, Stevenson, and Taylor (2004), many researchers continue to use the model that calls for identifying needs and areas for improvement, and establishing goals for their shared project from the onset.

In spite of all the work and research that has been done in the area of collaboration, some public school educators still feel universities are not responsive to their educational needs (Rollins-Searcy, Stevenson, & Taylor, 2004). This perception may exist because many individual university faculty members are involved with school districts but only at the individual school level.

Collaboration between a university and urban schools is greatly needed. Recent trends in urban communities indicate dense concentrations of poverty and people of

color (Rollins et al, 2004). The National Assessment of Education Progress (2004) reported that mathematical understanding of children of low-income families falls behind that of students in middle-income families. Students from low-income backgrounds trail behind peers from middle-income households in numerical knowledge before they enter school and the use of games can assist in closing the gap (Siegler & Ramani, 2008). These statistics demonstrate the importance of the eX-Games Project in urban communities.

Identifying the Need

The collaboration between a college of education and the public school was initiated when a clinical assistant professor of Educational Technology at the Mary Lou Fulton (MLF) Teachers College at Arizona State University was approached by an urban school with a high percentage of low socio-economic status students to provide needed supplementary mathematics materials. The principal of the school observed that many of her students were not motivated to learn mathematics and she was looking for an innovative way for students to practice and reinforce mathematics concepts.

Since pre-service teachers enrolled in a technology course had already been developing mathematics games as a part of the course curriculum, these games could serve as a valuable tool for assisting these K-8th grade students. From the onset, eX-Games was conceived as a project that would be delivered to multiple schools in various school districts. The purpose of the project was to provide mathematics board games to reinforce the state standards covered in the curriculum. The goal was to deliver eX-Games to as many K-8th grade students as possible, motivating students to learn mathematics concepts and providing opportunities that allow them to see mathematics in different ways. Through the use of board games, students can see how mathematics is applicable and valuable in their everyday lives.

The request for collaboration appealed on two fronts. First, elementary, urban city, low-income students at-risk would benefit from supplementary mathematics materials available to the schools on a continuous basis. Second, the collaboration between the MLF Teachers College and surrounding school districts is something that is respected, valued, and constantly explored as part of MLF Teachers College's mission to be embedded in the community. Furthermore, this collaboration allows faculty and pre-service teachers the opportunity to work directly with in-service teachers and their students to pilot pre-service teacher-developed mathematics materials.

Mathematics Board Games Research

Immediately after establishing the partnership, university faculty began to examine the educational benefits of using mathematics board games in the classroom. Preliminary findings supported the hypothesis that board games improve student achievement in mathematics (Siegler & Ramani, 2008; Ramani & Siegler, 2008). Burns (1998) reported that although a majority of American adults fear mathematics, they are mesmerized by mathematical puzzles. Moreover, Moscovich (2001) claims that games make mathematical thinking painless, interesting, and even fun.

People have long understood the value of games. “Tell me, I forget. Show me, I remember. Involve me, I understand.” This ancient, albeit timeless, Chinese proverb lays a universal foundation for the philosophy of education. Educators recognize that unless students are involved and engaged, authentic learning may not take place (Tate, 2008). Utilizing educational learning games accomplishes this; indeed, it is a valid teaching strategy. By incorporating challenge, novelty, feedback, coherence, and time, educational games speed up the brain’s maturation process (Jensen, 2001).

Proficiency in mathematics in the early grades predicts mathematics achievement in later years (Ramani & Siegler, 2008). The amount of board game experience young children bring to school from home correlates positively with their number knowledge (Ramani & Siegler, 2008). More specifically, playing linear number board games improves accuracy and understanding of number line estimates among young low-income, urban school students.

Tate (2009) supports the use of games as an effective strategy for delivering content knowledge to help students understand and retain important information. She states that the use of games is supported by brain research and learning styles theories (Tate, 2009). By observing hundreds of classrooms, Tate found that exemplary teachers use various strategies that help students make sense of learning. Games can be used to enhance motivation and improve students’ academic skills.

Setting the Goals

The partnership and articulation between a university and a school need to focus on mutual benefits to the institutions involved. Rollins-Searcy, Stevenson, and Taylor (2004) recommend that projects need to maintain a balance between social returns and investment, and financial gains. Based on this premise, the goals and objectives should link university and schools’ mission and vision.

The goals and objectives of the eX-Games Project are as follows:

- Produce quality instructional materials to reinforce state mathematics standards to increase the mathematical academic achievement of inner-city school students
- Utilize existing resources to minimize financial strain on school districts and the university
- Train pre-service teachers in the production of mathematics materials using technology
- Involve in-service teachers in the evaluation of instructional materials using state standards

Having established the impact that board games have on children’s mathematical ability, the project director, and co-author of this paper, incorporated existing research in her educational technology course curriculum. The purpose of these courses is to apply and integrate educational technologies in all mathematics curricular areas by examining theoretical and practical issues for diverse learners. Pre-service teachers are the ideal group to take these courses and undertake this project. They long for involvement in projects that will better prepare them to become teachers and that will actually be used instead of simply completing a task for a grade.

Technology provides equipment that is basically a tool that supports teaching and learning (Lever-Duffy, McDonald, & Mizell, 2003). The Association for Educational Communications and Technology (AECT) (1994) defined educational technology as the practice of designing, developing, using, managing, and evaluating resources for learning. More recently, educational technology was defined as “the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning” (Lever-Duffy, McDonald, & Mizell, 2003, p. 23). These definitions allow the teacher to explore multi-media resources to enhance instruction and improve student learning. Lever-Duffy, McDonald and Mizell (2003) assert that educational technology covers more than just the brand of computer or a specific type of camera; educational technology, in fact, can be any resource and process that facilitates learning. Thus, technologically designed and produced mathematics board games are an appropriate use of technological resources because they legitimize the intent inherent in the AECT definition.

Plan Implementation

Pre-service teachers enrolled in an upper-division technology course participated in the eX-Games Project to partially fulfill the course requirements. Careful attention and deliberate course design allowed pre-service teachers to complete the course objectives required by the MLF Teachers College and the Arizona Department of Education through assignments and activities that led towards a completed mathematics board game to be used in actual classrooms in the community. For example, pre-service teachers were required to demonstrate their understanding of incorporating Mathematics and Technology State Content Standards into their project. By having students complete a mathematics board game for the eX-Games Project that was based on specific content standards, pre-service teachers met the expectations of both the State and MLF Teachers College.

To prepare for the eX-Games Project, pre-service teachers reviewed the video, “No Gamer Left Behind: Virtual Learning Goes to the Next Level” (Edutopia, 2010). This experience helped the pre-service teachers understand that computer simulations are an effective tool for a generation of video game players – the students that will be sitting in their future classrooms. The pre-service teachers reviewed the relevant literature (eX-Games 01, 2010) to examine the effectiveness of games in the classroom. Next, pre-service teachers reviewed a number of sample games from previous semesters and the rubric (eX-Games 02, 2010) that would be used to evaluate the games they would develop by the end of the semester. The rubric included several different categories, such as creativity, use of graphics, appeal, and an evaluation of the rules, board, and game cards.

In the next steps, pre-service teachers reviewed the directions for the game, identified the State Mathematics Content Standards, and selected a grade level strand and performance objectives. They then completed a mathematics game proposal and submitted it to the course instructor for approval. Once the proposal was approved, the pre-service teachers started designing their game. There were multiple opportunities for the pre-service teachers to discuss ideas with each other and receive feedback on their progress from the course instructor.

After the mathematics board games were developed, they were posted on a shared website. Furthermore, eX-Games coordinators collaborated with local schools to sponsor a game day in which the pre-service teachers took their games and set them up in school cafeterias. Classes of K-8th grade students took turns playing the various games during class time. Many students chose to spend their lunch time continuing the use of the games. Game day was a useful experience for the pre-service teachers because it provided an opportunity to see how their games worked with students. In addition, in-service teachers often provided helpful feedback on the games, and many in-service teachers selected games they would like to use in their classrooms. Pre-service teachers knew beforehand that their games would stay at the school site. The pre-service teachers walked around and observed which games were popular with the students and took notes of games to download from the shared website to use in their future classrooms.

After Game day, the mathematics board games were collected and evaluated by the course instructor using the rubric that was introduced at the beginning of the semester. After the games were evaluated, they were reviewed by the course instructor and in-service teachers to determine the extent to which they met the criteria used in a K-8 school. This was important to ensure that the highest quality games were delivered to the classrooms. The teachers who reviewed the games were all master teachers and were initially selected by their principals to participate in this project because of their commitment to innovation in learning.

In-service teachers spent a significant amount of time deliberating the usefulness of the games in the classroom. The project director stated that it was like “watching kids in a candy store” for many of the teachers wanted to leave with the games that day. All of the board games were delivered to Title I schools first; recently, the program was expanded to more affluent schools and districts.

Benefits

The benefits of the collaboration exemplified by the eX-Games Project are reaped by all parties involved. The urban public school systems receive access to qualified mathematics teachers (Cavallo, Ferreira & Roberts, 2005). University preparation programs develop a reputation for meeting local school needs (Rollins-Searcy, Stevenson & Taylor, 2004). For the schools and in-service teachers, the pre-service teachers contribute ideas and enthusiasm, as evidenced by these quotes from classroom teachers:

There are many benefits from collaborating with pre-service and in-service teachers. First, as in-service teachers we have a tendency to get stuck in a rut in our classroom routines and time is always against us. It is refreshing to have innovative ideas to rejuvenate us. - Edtrae, eX-Games Project Certified Teacher and Mentor

The ideas students come up with are new and fresh. They have so much creativity, and it is nice to see all the new student-friendly ideas. It is obvious that the pre-service teachers who are creating the games have a genuine interest in students' learning and achievement....In today's fast-paced

classroom, with all the clerical and other responsibilities we have, it is difficult, if not impossible, to be able to be as creative as one would like. - Portia, classroom teacher

In addition, in-service teachers also commented on the academic benefits for their students of collaborating with pre-service teachers to develop mathematics board games. This project incorporates many different elements in new and different ways. This also allows me the opportunity to reach *all* of my students in a fun and educational way. - Rosalia, classroom teacher

As teachers, we don't have time to do the drill and kill. We need fun and interactive ways to have students practice and learn their math facts. Having mathematics fact board games allows students to have fun and learn at the same time.- Edtrae, eX-Games Project certified teacher and mentor

Having the pre-service teachers be able to take the concepts and develop games that will benefit the students without beating them over their heads with the "teaching" of a concept is an invaluable aid.- Portia, classroom teacher

At the MLF Teachers College, professors as well administrators recognize the value of preparing future teachers by providing them with hands-on experiences of developing instructional and learning materials that will be used by and provide support for teachers and students in our community classrooms. A MLF Teachers College administrator stated:

Since the MLF Teachers College's mission is to prepare excellent teachers who will make a difference in PreK-12 schools, it is imperative that our instructors are involved in schools and are supporting teachers who are currently there. This project not only helps students achieve, it advances the MLF Teachers College mission.
- Laura, MLF Teachers College administrator

Conclusion

Through collaborative endeavors such as the eX-Games Project, we can bring together resources and expertise to the benefit of all stakeholders. For schools and teachers who are too often overburdened, pre-service teachers can provide enthusiasm and much-needed resources. For pre-service teachers, the benefit of working with practicing teachers and students in high-need communities provides the authentic experiences that will prepare them to serve students in their future classrooms. For professors as well as teacher preparation programs, the opportunity to impact communities and understand the features of today's classrooms helps achieve the mission of preparing innovative educators through collaboration.

The eX-Games Project is a model of how we can work together to help students reach their full academic potential. Although we acknowledge that further quantitative and qualitative research is needed to better understand the benefits of the

eX-Games Project for students and pre-service teachers, we believe that through such collaboration mathematics concepts and ideas can be taught and reinforced in fun and creative ways that can ultimately help traditionally underserved communities close the academic achievement gap that continues to exist (Siegler & Mu, 2008). In fact, efforts are underway to expand the eX-Games Project to other universities and districts around the country as we simultaneously collect data on the effectiveness of games in the classroom and the benefits of the project for all involved. It takes all of us working as partners to open doors of opportunity for all students

References

- AECT. (1994). *Instructional technology: The definition and domains of the field*. Bloomington, IN: AECT.
- Burns, M. (1998). *Math: Facing an American phobia*. Sausalito, Ca: Math Solutions.
- Cavallo, A. M. I., Ferreira, m. M. & Roberts, S. K. (2005). Increasing student access to qualified science and mathematics teachers through an urban school-university partnership. *School Science and mathematics*, 105, 363-72.
- Curcio, F. R., Artzt, A. F. & Porter, M. (2005). Providing meaningful fieldwork for pre-service mathematics teachers: A college-school collaboration. *Mathematics Teacher*, 98, 604-609.
- Edutopia. (2010). Schools use games for learning and assessment. Retrieved from <http://www.edutopia.org/no-gamer-left-behind> on July 27, 2010.
- eX-Games 01. (2010). Current research. Retrieved from <http://sites.google.com/site/mathgamesintheclassroom/current-research> on July 27, 2010.
- eX-Games 02. (2010). Games in the field. Retrieved from <http://sites.google.com/site/mathgamesintheclassroom/game-rubric> on July 27, 2010.
- Jensen, E. (2001). *Arts with the brain in mind*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Jones, B. D., Stallings, D. T., & Malone, D. (2004). Prospective Teachers as Tutors: Measuring the Impact of a Service-Learning Program on Upper Elementary Students. *Teacher Education Quarterly*, 2004, 31, 3, 99-118.
- Lever-Duffy, J. McDoanld, J. B. and Mizell, A. P. (2003). *Teaching and Learning with Technology*. Boston, MA: Allyn and Bacon.

- Moscovich, I. (2001). *The big book of brain games*. New York, NY: Workman Publishing Company, Inc.
- National Assessment of Educational Progress (2004). *NAEP 2004 trends in academic progress: Three decades of student performance in reading and mathematics* (Publication No. NCES 2004564). Retrieved 5 April 2006 from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2005464>.
- Ramani, G. R., & Siegler, R. S. (2008). Promoting broad and stable improvements in low-income children's numerical knowledge through playing number board games. *Child Development, 79*, 375-394.
- Rollins-Searcy, R., Stevenson, J. M., & Taylor, V. (2004). Reading and mathematics alliance-building for urban precollegiate and postsecondary ecosystems. *Reading Improvement, 41*, 113-121.
- Siegler, R. S. & Romani, G. B. (2008). Playing linear numerical board games promotes low-income children's numerical development. *Developmental Science, 11*, 655-661.
- Siegler, R. S. & Mu, Y. (2008). Chinese children excel on mathematics problems even before elementary school. *Psychological Science, 19*, 759-763.
- Tate, M. L. (2008). The biology of human play. *Child Development, 63*, 599-600.
- Zenger, W. & Zenger, S. (1982). *Curriculum planning: A ten-step process*. Palo Alto, CA: Research Associates.