# ALTEC Learning Games: Successful Integration of Learning and Gaming

**by**

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**Abstract**

Of the 53 million K–12 students in the United States, 93%, or 51 million, of them play video games (Etuk, 2008). ALTEC Learning Games utilize the excitement of video games to engage students and provide teachers authentic online resources that reinforce skills in math and language arts. Our recent work was partially supported by a partnership with the Ohio Board of Regents through the federally funded Star Schools Program. This work demonstrates the use of online games, including single player and competitive and collaborative multiplayer formats, on both computers and emerging mobile technologies (EMTs).

**Why Games?**

Since youth appear motivated to spend increasing amounts of time engaged in electronic games (ESA's 2006; Pew Reports, 2008), many researchers argue that games have a significant pedagogical potential to support classroom instruction (Dempsey, Lucassen, Haynes, & Casey, 1997; Foreman, 2004; Prensky, 2001; Squire & Jenkins, 2008). Students can acquire high levels of skills in playing these games by processing quickly and in parallel with other information, and exploring in a non-linear fashion (Prensky, 2001). Learning happens within the context and culture of a society and a well-designed game promotes community learning (Foreman, 2004; McLellan, 1995), with games utilizing user-generated content and participatory entertainment. Prensky notes that that Herz (1997) opens her book, Joystick Nation, with the assertion "videogames have created a cadre of screen manipulators (pp.1-2)." She argues that the very "mental grammar" kids use to describe and interpret the world will be different from that of older generations raised on television.

Games also challenge youth in ways they appreciate. Students are not usually excited about doing difficult things -- a problem to which all teachers and parents can relate. Gee (2003) suggests that schools have traditionally used two methods of getting students to do difficult work: either force them or make the work less challenging. Current thought suggests that because games are engaging, they can be an effective instructional support and have a place in learning (Van Eck, 2006). Game developers recognize that most youth who play games don't want them to be short and easy. Indeed, Jenkins (2006), of MIT's "Education Arcade" initiative, observes that students will complain if a homework assignment is too hard and if a game is too easy. Game developers attempt to make games challenging enough that players enter what they

call “the zone” or “the flow,” a term based on the work of psychologist Mihály Csíkszentmihályi (Chen, 2008; Csíkszentmihályi, 1975). The concept of “flow” has been cited in the growth of “Dynamic Difficulty Adjustment” (DDA), in which computerized tests present successively harder material until the test taker reaches a suitable difficulty level, and in “over learning,” in which skills are practiced beyond the level of mastery, to facilitate automaticity and fluency.

In 1995, Burnstein and Kline predicted that the most exciting opportunity for game owners lay in sharing the experience and playing against other players. Since then, a significant percentage of games, both computer and console, support collaborative play and many game players have emerged for whom no other type of game is as compelling (Yee, 2006). In his study of motivation in collaborative games, Yee (2007) identified three components that make an online game compelling. *Immersion* includes the concept of "flow" as discussed above, as well as the non-relevant (for our purposes) concepts of role-play and escapism. *Achievement* includes the status gained by high scores and the acknowledgment of success by peers. Finally, *Social components* that make a collaborative game compelling include teamwork, supporting personal relationships, and socializing.

**ALTEC Learning Rate-Based Games**

ALTEC game development to help students learn basic math and language arts skills is based on building "automaticity" and "fluency" (Binder, 1996; Bower, & Orgel, 1981; Hook, & Jones, 2002; Lindsley, 1990; Snyder, 1992; White, 1986). The games challenge students to respond quickly over a series of short, timed trials. As they play, students become fluent in the skills being practiced, such as recognizing examples or non-examples of ratios and calculating math operations such as multiplication and addition. Students develop retention, or the ability to perform a skill or recall knowledge, as well as the ability to apply what is learned to perform

more complex skills in new situations.

Our games help improve student performance through increased time on task, student motivation and engagement, and corrective feedback. Many ALTEC Learning Games challenge students to respond quickly over a series of short, timed trials to increase the rate of correct responses and decrease error rate until responses become automatic. The multiplayer game format, such as Jet Ski Addition (ALTEC, 2007; see Figure 1), motivates learners (Garris et al., 2002) through the use of sustained feedback related to progress through competition against three other players.

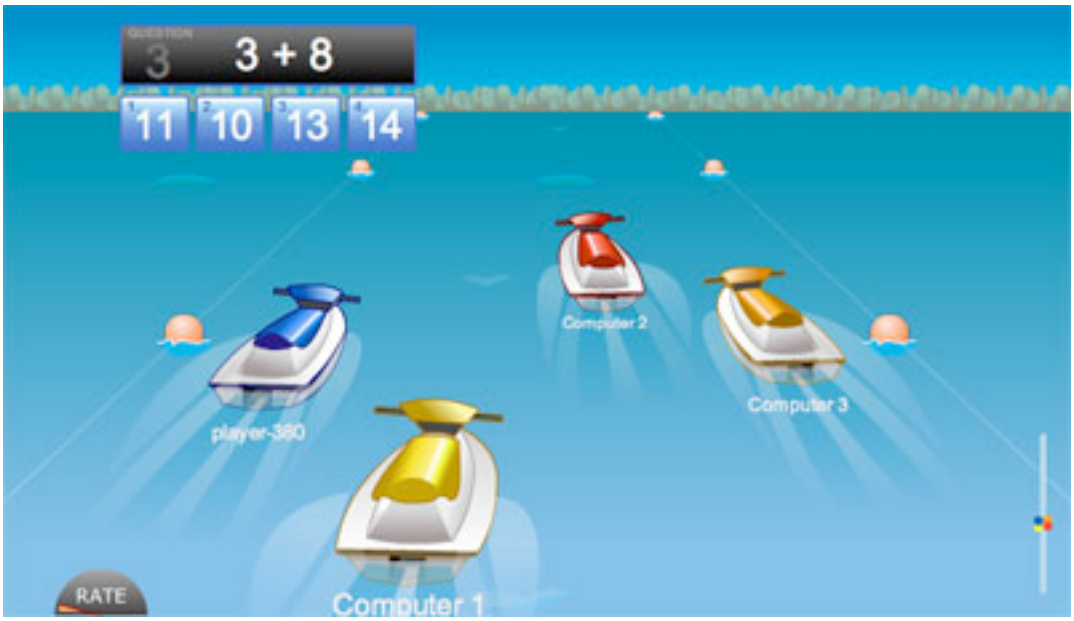


*Figure 1. Jet Ski Addition*

Game play is intended to increase fluency in the mathematics concepts being practiced. As students play, their rate of response increases and error rate decreases until they respond to the questions automatically. Students select their game play based on skill level and have the option of setting a few preferences during the game, such as turning sound on or off. The game provides students with immediate feedback about their performance by incorporating specific design elements. These elements include, for example, a "Time" feature and character movements

during game play. Students also receive detailed feedback at the end of the game in the form of an interactive chart that explains the items missed and encourages students to play again.

Feedback is also provided in the form of an interactive Progress Chart displayed at the end of game play. This chart provides students with immediate feedback about their correct and incorrect responses across multiple game sessions. The rates of both correct and incorrect responses are charted and a line that represents an increase in the rate of correct responses and a decrease in the rate of incorrect responses represents student achievement. This strategy of feedback is based on the concepts of *Precision Teaching*, an instructional strategy developed by Dr. Ogden Lindsley at the University of Kansas (Lindsley, 1990).

Rate-based games implement a key proposition of Precision Teaching: rate of responding is a critical component of learning. Therefore many game features focus on repeated practice of isolated skills to promote fluency. The use of the interactive Progress Chart allows both teacher and student to systematically record performance information, observe changes in performance, and to make performance-based decisions about immediate and long-term curriculum needs. The use of rate as a component of instruction is also supported by Marzano (2005) as a strategy most likely to improve student achievement. These games provide reinforcement of homework and practice exercises that promote automaticity and fluency, corrective feedback, and a connection between students' efforts and outcomes.

**Making Games**

Even though the focus of the games is instructional, the process of making the games involves players, students and teachers working with us, letting us know what is fun and sharing ideas about game scenarios. ALTEC staff visit students in classrooms or after-school clubs regularly throughout the game design and development process, and welcome the opportunity to

gain feedback throughout. Three snapshots of our field work represent the various steps in game development, including iterative design, field testing, and implementation. We receive both formal and informal feedback, ranging from organized field tests to informal responses from teachers who share stories about the successful integration of ALTEC Learning Games in their classrooms. We have almost 100,000 unique visits to our web-based game resources each week.

Our development process to create a game that meets the needs of the target audience is based on the three components recommended by Bannan-Ritland (2003) in her Integrative Learning Design Framework. These include understanding the situation, finding solutions, and evaluating the solutions. During the process of understanding the situation, our design and development team identifies how games are used during instruction, and how they might work within the classroom. This involves an understanding of both the standards being addressed and the instructional integration of games. Understanding the needs of the target audience strengthens the likelihood of developing a game that achieves desired outcomes. After an initial analysis, the process of finding solutions involves multiple visits with students and teachers. These individuals provide usability and feasibility feedback on static paper prototypes as well as dynamic visual representations of the game space, flow, and challenges. The iterative design process also includes evaluation for local impact using both quantitative and qualitative methods to test usability and to evaluate feasibility and learning.

A Traffic Safety Game. The Learning Game Team at ALTEC worked with the Boys and Girls Club of Lawrence, KS to develop a multiplayer race game that supports a safe driving curriculum developed for middle school students. Middle school students, the target audience, were visited three times throughout the iterative design process to observe their behavior during game play. The Boys and Girls Club provided technology, Internet access, and a classroom for

the iterative process with student participants.

The initial concept included a multiplayer race game. Students raced their vehicles by answering traffic safety questions. An additional feature introduced during the iterative analysis with students was the use of a pit stop area that provided players with the opportunity to get a power boost during game play while answering more detailed questions about traffic safety. Data collection included observations of students' choices and behavior during game play and quantitative data in the form of a questionnaire adapted into a youth-friendly format from the System Usability Scale developed by Digital Equipment Corporation (Brooke, 1996). These data were recorded during each visit and provided a good combination of qualitative and quantitative data to inform game development. For example, students were asked to rate their willingness to play the game based or their perception of learning as a result of playing it. Data provided ALTEC with direction on minor areas of improvement, including the development of more visual cues that suggest the purpose and reward for entering the pit stop, and strategies to streamline the process of entering games hosted by players in the staging area (see Figure 2).


*Figure 2. Staging Area*

Testing Middle School Math Games. The ALTEC Learning Game Team participated in a

structured field test process as part of a STAR Schools Project (Wexford, 2008). During supplemental class periods, or mathematics labs which provide an additional period of mathematics for select students, and in after-school learning environments the Team developed and evaluated different types of mathematics games for use with mobile technologies. The field test model provided students with access to a specific set of four mathematics games three times a week for approximately one hour each day (Wexford, 2008). The games were designed to provide opportunities to practice ratio, proportion, and number line (Wexford, 2008). The district provided a wireless laptop cart and classroom for implementation of the program and the STAR Schools Project provided access to emerging mobile technologies (EMTs) including digital video cameras, web cams, and iPod Touches.

Evaluators administered an online feedback survey to participating students (n=70). Students used a five-point rating scale to indicate the extent to which they liked a game or video. The scale options were: bad, not that bad, just okay, good, and great. Students were allowed one choice to indicate which one of the games played during the field test was their favorite. Most students (43%) preferred the multiplayer Matrix Racer game as opposed to the other three games that were single player games (see Figure 3).

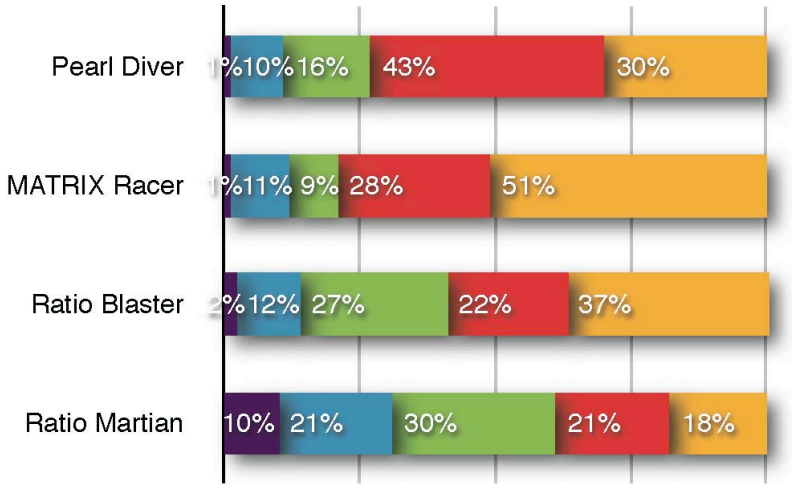

*Figure 3. Matrix Racer Feedback*

Games in the Classroom. A number of teachers report strategies for integrating multiplayer challenges into existing curriculum to improve student achievement. For example, Laura S. wrote:

> As second grade teachers, we decided at our bi-weekly grade level meeting to make it a goal to improve math scores. I introduced Jet Ski Addition to the class using an in-focus box to project it on the screen and got the children excited about trying the game. The children could hardly wait for their turn. The classroom computers became quite a distraction to the class. They all wanted to know the web address, so I had to write it down and send out a parent note.
>
> I decided to use the site during my class computer time in the lab. By this time, many of the kids were familiar with the site because they had tried it at home. The class time was perfect for those who did not have a computer at home, or who needed a little extra support with how to play the game. We talked about how we could use "secret names" like Polar Bear and Mr. Penguin and Scottie, but the kids wondered how we would know it was a classmate they were playing against. We decided to add our class room number 103 after our "secret names," so that we would know when someone from our classroom was playing. The names were a nice option for those children who wanted to play against a classmate, but desired to remain anonymous.
>
> We shared the game it with the three other second-grade classrooms in our building. They could use their names followed by their own classroom numbers and then we could play other kids from our school. Suddenly indoor recess became an exciting Jet Ski race across the hall! We told our recess and computer aides about the game, so they could play against us too.
>
> Suddenly, teachers were playing against students as well as each other each night. This all happened in a matter of a few days. I heard comments such as "I played Jet Ski last night for two hours!" and "Who is The Big Bad Wolf?" and "Mrs. Smeltz (Scottie103), I beat you last night!" and " I played Mrs. Fausnacht (Skippy204) and Miss Erb104(why isn't this in the same form as the two previous?) last night!" and "What time will you be on tonight?" It was very exciting to see the kids wanting to practice those facts in a friendly, competitive way. I told the other teachers - "If we can't beat them, I guess we have to join them!"
>
> Many of the students play video games all the time at home. This was a way to let them enjoy their playing time, but to practice a skill at the same time. Many of the parents commented on how excited they were that their children were practicing their facts. The results include:
>
> Test 1 14 out of 24 children passed with 80% or higher

Test 2  20 out of 24 children passed with 80% or higher ten days later

You can read more Success Stories at http://arcademicskillbuilders.com/aboutus.htm.

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