Games vs. Conventional Instruction

July 2015

Do curriculum based games and non-conventional strategies provide a more positive response to intervention (RTI) than the conventional style of teaching?

Research conducted by J & J Educational Boot Camp

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Introduction

"Since there is a public good and large social returns to the nation associated with improving education and workforce training outcomes, the U.S. Departments of Education and Labor and the National Science Foundation — in partnership with industry, educators, and the academic community — should support an R&D agenda that would encourage the development of educational and training games for K-12, post-secondary,"

FAS Learning Science and Technology R&D Roadmaps

The United States of America, the worlds leading super power, has fallen far behind many so-called less developed nations in math. Now ranking 23rd in science and 31st in math standardized testing, the U.S. needs to re-evaluate our methods of teaching math and science, beginning at the primary level. We must explore "non-conventional techniques" (NCT), such as curriculum-based games strategies to produce excitement for learning and inevitably, spark improvement in our test scores. We must also produce a research-developed, refined, and tested model of professional development for primary science and math teachers.

"Rather than thinking about existing classroom activities and figuring out how we can somehow wrap a game around it, we need to think out of the box about ways that we can create integrated learning scenarios using game structures, that then fit somewhere within the teacher's curriculum for the day."

Howard Phillips, Microsoft

The area of emphasis in this treatise is a teaching model that inspires competition in the classroom by using curriculum-based games and a process called "unwrapping the benchmarks". The target is the State of Florida and the aim is to demonstrate how "Science Boot Camp" and "Math Boot Camp" games can increase student testing aptitude. The questions to be addressed are as follows:

1. Compared to conventional instruction, do the Science and Math Boot Camp games provide a more positive “response to intervention” (RTI)?

2. Can the Science Boot Camp and Math Boot Camp games increase aptitude in standardized testing?

3. By combining the element of game play, with other non- traditional “Boot Camp Strategies), are the Science and Math Boot Camp resources a more effective means of intervention than conventional methods?

In 2007, the year that J & J Educational Boot Camp released its first program, Science Boot Camp, the State of Florida’s fifth graders were testing at 42% proficiency in science. In math, Florida’s fifth graders were testing at 59% proficiency. In 2012, Florida’s fifth graders tested at 51% proficiency in science and 57% proficiency in math. Florida’s science scores suggest that while progress is being made in science proficiency, conventional instruction is just not enough. Florida’s math scores are indicative of the fact that conventional instruction is just not working.

Experts on Games and Conventional Instruction

What the experts say concerning conventional instruction

At the ITE Teacher's Conference 2003 Innovation in Teaching and Learning in Singapore**,** lecturer Ruhazat B. Adnan presented his paper saying:

> The current practice of delivering lesson review through PowerPoint presentation, lack[s] the impact that will engage the learners, in this case, students. Often, students are put off by the same unilateral delivery of the lesson review…. Quite often, teachers find that concepts taught in class, are not grasped well by their students. Some students were noted to be less attentive while others were dead bored with theory lessons that were too "heavy". They also lamented that students could not remember the lessons taught despite the summary at the end of each lesson. More often than not, students themselves felt unmotivated by the manner the Q & A summary was presented. They were simply not interested… The introduction of Game shows in the classroom deviates from conventional lesson delivery and introduces a play element in the lesson. Playing games reinforces learning.

The case for educational games

"*One of the major advantages of games over other forms of instruction is their motivational property. Boring problem sets and drills in conventional instruction can become addictive puzzles in the context of a game*."

> Henry M. Halff, Halff Resources Adventure Games for Science Education: Generative Methods in Exploratory Environment

Educational Games and Simulations

At the ITE Teacher's Conference 2003 Innovation in Teaching and Learning in Singapore, "Educational Games and Simulations", written by Angela Moore, was referenced and read as an example of the effect of games and simulations on educational proficiency in students. Her piece is as follows:

Introduction

Educators are continuously searching ways to enhance initial learning and transfer of knowledge, and technology has become a valuable resource for fulfilling this task. Educators and instructional designers are using technology to create phenomenal programs, involving gaming and simulations, to improve methods of teaching and to relate skills to realistic situations. Although there are many supporters of educational games and simulations, there a few who believe that learning does not entail computer-generated fun.

During the late 1950s, games and simulations entered the broad educational scene, but it was not until the early 1970s that the tools were introduced to the educational world. At this time, games and simulations were a part of the instructional design movement. Prior to this time, these tools were being developed for military use only. Unfortunately, after their popularity in public schools, in the 1960s, the use of games and simulations declined with the emergence of the basic-skills movement (Gredler, 2001).

Due to the increased power and flexibility of computer technology, there has been a renewed interest in games and simulations. This interest coincides with the current perspective of effective instruction, in which, meaningful learning depends on the construction of knowledge by the learner (Gredler, 2001). Games and simulations allow learners to construct their own meaning and understanding of a situation, which is a desired experience for students. Through continuous research, educators may further understand the concept and purpose of games and simulation.

Definition of Games and Simulations

The terms game and simulation are often used interchangeably. Although games may take on certain attributes of simulations when they replicate, real-life situations, they are not exactly the same. Usually, games are used for reviewing concepts, whereas, simulations involve applying previously learned skills and knowledge to understand new concepts. (Games and Simulations, n.d.)

Games

Educational games are contests in which the player(s) and opponent(s) operate under rules to gain a specified objective based upon learning (Seay, 1997). These programs are highly non-linear and typically provide a minimal and non-intrusive interface (Levin, 1999). Games consist of rules, winners, and losers, and have a goal that is either stated or inferred. The following list contains examples educational games: adventure games, business games, board games, combat games, logical games, and word games.
There are three basic types of scenarios that can be incorporated into any game. The first is a real scenario (ex. Africa Trail) which is one that exists in real life. The second type, an unreal scenario (Carmen Sandiego), is something that exists in real life, but in a different form. Finally, a fantasy game is the third type of scenario. A fantasy game (The Magic School Bus) is one in which the scenario is purely a figment of the imagination (Alessi, 2001).

Simulations

Computer simulations are models of real-world systems that allow exploration of complex interactions within that system and ultimately extract some meaningful conclusions. They encourage the learner to explore, experiment, and take risks. Due to their simplistic, artificial representation of realistic situations, students should be encouraged to identify the differences between the simulation and the real world (Levin, 1999). A simulation does not just replicate a phenomenon; it also simplifies it by omitting, changing, or adding details or features. Educational simulations may also add elements not present in the real world, such as coaching, providing feedback, or hints (Alessi, 2001).

To people of different disciplines, the word simulation has different a meaning, therefore, simulations are classified into four categories to help clarify these differences. Simulations can be divided into two groups based upon their main educational objective. The two groups are simulations about something and simulations on how to do something. There are two subcategories in each group. Physical and iterative simulations are about something, and procedural and situational simulations refer to how to do something.

In physical and iterative (process) simulations a physical object of phenomenon is represented on the screen, giving the user an opportunity to learn about it (photosynthesis). In the iterative simulation the user is allowed to run the program repeatedly without time restraints. Procedural simulations are designed to teach a sequence of actions to accomplish some goal (ex. flying an airplane). Situational simulations deal with the behaviors and attitudes of people or organization's in different situations, rather than with skilled performance, and most incorporate role-playing (Alessi, 2001).

Structure of Games and Simulations

Two important concepts in games and simulations are surface structure and deep structure. Surface structure refers to the paraphernalia and observable mechanics of an exercise. For example, in games are drawing cards, moving pieces around a board, and so on. In contrast, an essential surface structure component in a simulation is a scenario or set of data to be addressed by the participant. (Gredler, 2001)

Deep structure is the psychological mechanisms operating in the exercise, and it refers to the nature of the interactions between the learner and the major tasks in the exercise, and between the students in the exercise. For example, the extent of student control in the exercise, the learner actions that are rewarded in the exercise or which receive positive feedback, and the complexity of the decision sequence in the exercise (Gredler, 2001).
The deep structure of games and simulations varies in three important ways. First games are competitive exercises in which the objective is to excel by winning. Players compete for points or other advances that indicate they are outperforming the other players. In a simulation participants take on demanding roles such as, concerned citizens, business

managers, interplanetary explorers, or physicians, or professional tasks such as exploring the causes of water pollution or operating a complex equipment system, and the learners assume the responsibilities of these roles with the related privileges and consequences (Gredler, 2001).

The second difference is that the event sequence of a game is typically linear, whereas a simulation sequence is nonlinear. The player or team in a game responds to a stimulus, typically a content-related question, and either advances or does not advance, depending on the answer. This sequence is repeated for each player or team at each turn.
On the other hand, in simulations the learners are faced with different problems, issues, or events that result from action taken in their prior decisions. In a computer delivered simulation, this feature is referred to as branching (Gredler, 2001).

The third difference between simulations and games is the mechanisms that determine the consequences to be delivered for different actions taken by the students in the exercise. Games consist of rules that describe allowable player moves, game constraints and privileges, and penalties for illegal actions. Also, the rules may be imaginative, or not related to real-world events. In contrast, the basis for a simulation is a dynamic set of relationships among several variables that change over time and reflect authentic causal processes (Gredler, 2001).

Advantages and Disadvantages of Games and Simulations

Simulations and gaming can be powerful tools when used properly and in the right setting (Seay, 1997) emphasis added. Simulations are designed to help students experience a system of problems and not just read or hear about them, whereas games are designed to drill students on previously learned concepts. Both tools have their advantages and disadvantages in the educational setting.

Advantages

Games and simulations have significant advantages over other learning designs, for certain skills. They are particularly useful for teaching many subject areas that are very difficult to teach using other teaching methods (Franklin, n.d.) emphasis added. The following list contains some of

advantages of games and simulations reported by the Franklin Learning Systems.

Games and simulations:

- are successful for getting and holding the learners' attention.
- are good at teaching hard-to-teach facts.
- are multimedia in nature and are great for special needs students.
- build social skills.
- improve math and reading skills in addition to teaching their targeted content.
- are different from conventional activities and are welcomed by populations that have not succeeded in most school activities

Disadvantages

Although technology, such as gaming and simulations, can be used to engage learners in rich and meaningful activities, there are some doubts and disadvantages to consider. As with any method of instruction, educators will have their doubts. *When referring to games, educators are concerned with whether games are intrinsic or extrinsic motivators, and whether or not such methods should be used in the classroom. Often times, there is a conflict between the educational goals and the characteristics of the games.* (emphasis added) Whereas, others are concerned that simulations over simplify or distort reality.

According to CSU online Educational Technology report (n.d.), simulations are very costly and time consuming, and will never replace the need for actual experience. Other reported disadvantages are: fun may overshadow purpose of games and simulation, difficulty in measuring outcomes in simulations, and lack of efficiency of learning in games.

Games and Simulations vs. Conventional Methods

Educators often debate whether or not games and simulations are better than conventional teaching methods. Like with other forms of instruction, simulations and games are likely to be more effective with some students than with others. *In 12 of 14 studies, students reported more interest in*

simulation and game activities than in more conventional activities. Also, simulations and games show greater retention over time than conventional classroom instruction (Randel, 1992).

The instructional goals for which each method (games, simulations, lecture, or discussions) can be most effective often differ. The lecture method is likely to be superior in transmitting items of information. In contrast, simulations have the potential to develop students' mental models of complex situations, as well as their problem-solving strategies (Seay, 1997), and games increase retention and recall more so than worksheets and flashcards.

Charles Petranek, a professor at the University of Southern Indiana, noted that some students might not readily take to computer generated learning situations. He found that an adverse side of simulations was that not all students relished this exciting method of discovery. Some students preferred the traditional methods of listening to a lecture, taking notes, and studying for a multiple-choice test (Seay, 1997).

In 1996, Major Curtis A. Carver, Jr., college professor (engineering), reprogrammed a commercial game to adapt to a specific educational use in his classroom. The game was designed to reinforce previously taught skills through drill and practice.

He observed that students spent many hours after class trying to beat the game and were therefore much more exposed to the material than those who chose not to participate in the games. *As a result, the students who used the games scored higher on the test than the others (Seay, 1997).*

Before 1984, 68 case study reviews revealed the impact, directly or indirectly, of the difference between simulations and games versus conventional instruction on student performance. The following are the results:

- 56% found no difference
- *32 % found differences favoring simulations/games*
- 7% favored simulations/games, but their controls were questionable
- 5% found differences favoring conventional instruction

Lecturing is noted to be effective is some cases, but may not be the most efficient way to teach students about certain concepts, such flying a plane, treating and diagnosing patients, or making human resource decisions. These skills require the learners to be place in a realistic setting. *Through games and simulations, the experience may impart learning in an area that is very difficult to teach using other learning designs* (Franklin, n.d.). Overall, the instructional method depends on the instructional goal.

Conclusion

Since the 1950s, games and simulations have been used to enhance the learning process. Currently, in the educational setting, these tools are being used to increase initial learning and transfer of skills. Though the two have similar surface structure, they have very different deep structures. Both, games and simulations are designed to take the learners into another world, either for competitive or role-playing situations. Compared to traditional methods of instruction, gaming and simulations are often chosen

Boot Camp Games Analysis

The evidence is convergent. Games are more effective in raising student achievement level than conventional instruction. Taking a look at the two programs of J & J Educational Boot Camp, Science Boot Camp and Math Boot Camp, the following evidence shows how they fare versus conventional instruction.

Science Boot Camp

The Science Boot Camp Program consists of four games along with teacher resource materials. Listed below are the games and game styles:

- Relay Race (Board Game)
- Vocabulary Fitness (Bingo Game)
- Speed Bag (Drawing Game which combines drawing science concepts with more in-depth application and practice given in the Speed Bag practice booklet)
- Bench Press (Jeopardy-style computer game)

Math Boot Camp

The Math Boot Camp program consists of three games and student practice booklets with a review module on CD-Rom. Listed below are the games and game styles:

- Math Triathlon (Board Game)
- Company Drill ("I Have, Who Has" Card Game)
- Math Rock Climbing (Jeopardy Style Video Game)

Notice that all of the games of Science and Math Boot Camp use competition as the theme. The goal is to promote healthy competition in the classrooms, thereby increasing students' motivation and interest in learning.

In October 2005, the same year J & J Educational Boot Camp created the Science Boot Camp line of curriculum based games, the Federation of American Scientists (FAS) convened a national summit on educational games. There, it was determined that there are several attributes of games that would be useful for application in learning. These include:

- Contextual bridging (i.e. closing the gap between what is learned in theory and its use)
- High time-on-task
- Motivation and goal orientation, even after failure
- Providing learners with cues, hints, and partial solutions to keep them progressing through learning
- Personalization of learning
- Infinite patience

The FAS went on to say "*there are differences between games for education and games for entertainment. Developers of an educational game must target the desired learning outcome, and then design a game to achieve that target. Educational games must be built on the science of learning. Educational game designers must also design for third-party users of their applications who support, augment, and monitor player progress."*

Relay Race and Triathlon Games

We will first review the games, “Science Relay Race” (Science Boot Camp) and “Triathlon” (Math Boot Camp).

Relay Race:

The object of the “Relay Race” is to reach the finish line with a platinum medal. But, along the way the player will land on spaces that will prompt the player to pick up a question card from one of four question card decks. These four question card decks cover the four clusters of benchmarks set by the State of Florida for the FCAT. Those four clusters cover, **The Nature of Science**, **Physical Science**, **Earth and Space**, and **Life Science.** “Relay Race” also promotes personalized learning in that each player has the opportunity to internalize what is learned through repetition of game play.

This also marks the beginning of closing the gap between what is learned in theory and its use, because the student must first learn the content before understanding practical application of what is learned. “Relay Race” first sets the state’s benchmarks as the goal in a way that is motivational to the student because now the student is in competition with his fellow student to **learn** the content knowledge so that he can **win** the race.

Triathlon:

The object of “Triathlon” is the same as “Relay Race”. Both games are premised on the idea of running a race, but unlike “Relay Race”, where the race is on a track field mined with questions on science content, Triathlon’s race is made of three events with three fields of play; Swimming, Cycling and Running. Each field of play encompasses the five “Domains” of the Common Core Standards. The Swimming event encompasses domain 1 and 2. The Cycling event encompasses, domain 3, and the Running event encompasses domains 4 and 5.

The first thing that teacher and student will notice on the question cards of either game is the benchmark or standard at the bottom of the card. The game card questions are in multiple-choice format. Because the answers are on the back of the cards, each player will ultimately learn the answer to

the question even if no one at the table was able to guess the correct answer. Relay Race and Triathlon are games that capture the attention of the player, therefore keeping the student "on task". The multiple-choice format of the game gives the player hints and or cues to promote reasoning.

It is a well known fact that games can relieve the stress often associated with conventional class settings. As concluded at the 2003 ITE conference, stress relief reinforces learning. Another conclusion was that entertained students learn more.

Vocabulary Fitness and Company Drill Games

The second duo of games we will review are called "Vocabulary Fitness (Science Boot Camp" and "Company Drill" (Math Boot Camp)

Vocabulary Fitness:

This game is a bingo game that reinforces science vocabulary terms and their meanings. As with Relay Race, this vocabulary game covers the four clusters of Florida's current Next Generation Sunshine State Standards (NGSSS). In fact, all Science Boot Camp games and teacher resources are specifically aligned to the Florida State Standards. In 2005 the Federation of American Scientists summarized important attributes for design of educational games as follows:

- User centricity
- Novelty
- Rewards
- Intuitive control
- Bite-sized chunks of gaming
- Diagnostic
- Enticing
- Measurable progress
- Cool factor
- Immediate feedback
- Moves a learner through multiple levels of achievement
- Keep players at the edge of his or her skills but don't over-challenge
- Emulate familiar patterns
- Build both generic and specific skills
- Self-directed play
- Adaptive

- Provide tasks to fill gaps in knowledge or skill
- Provide sense of mastery
- Requires active problem solving
- Delivery of some ambient information
- Build skills that can be carried forth in new games
- User assistance, but not heavy-handed assistance
- Motivate learner to move toward the goals and the learning experiences

Vocabulary Fitness encompasses all of these attributes, but it is here emphasized that building science vocabulary along with basic skills is specifically important because science vocabulary is carried over into and is an integral part of each Science Boot Camp resource.

The following are excerpts from a study on how Malayan Chinese students learn English vocabulary through the use of a vocabulary board game. (Please take note that the following is from actual transcripts written by the author listed)

Excerpt one

Norhani Ahmad Jaya, Faculty Of Education, UKM

> The Creative Project developed by the researcher is a board game used in teaching reading and **vocabulary** to Form 2 students. The board game, which is named "Travel in Space", is specifically designed to promote independent learning. The researcher develops the project based on two research questions. The first question is "Can the board game be an effective teaching tool to teach reading and **vocabulary**?" and the second question is "Will the students (subjects) favor the board game introduced to them?" In order to seek the answer for these two questions, the researcher conducted an experiment by employing the 'pretest, posttest, control design in Sek. Men. Abdul Jalil, Hulu Langat. The samples chosen for the experiment were Form 2 students. The students were then divided into two groups namely the experimental and control groups. During the period of experiment, both groups were given the same pretest and posttest. However, only the experimental group was given the treatment (board game). Both groups were also given two different sets of questionnaire to answer. Four ESL teachers were also given a

set of questionnaire each to answer. Then, the researcher analyzed the data gathered from the instruments mentioned, together with her personal observation, in order to answer the questions posed. From the analysis, it is evident that the subjects like the board game and the difference in the mean scores of the results obtained by both groups in the posttests shows that the board game is an effective teaching tool in the teaching of reading and **vocabulary** to Form Two students of the intermediate level.

Excerpt two

Azzuhri Busu Leman, Faculty Of Education, UKM

> This study aims at examining the effectiveness of using language games in the teaching of **vocabulary** to Form Two students. There were 28 students involved in this study. All of them were from the Sekolah Menengah Seri Ampang, Ipoh, Perak. The students were divided into two groups, the Experimental Group and the Controlled Group. The Experimental Group learned the lesson with the aid of language games. On the other hand, the Controlled Group learned the lesson with the traditional methods. Basically, the researcher himself devised the language games. The researcher has adapted an activity in the students' textbook and turned it into a language game activity. At the end of the study, the researcher has conducted a test on both groups. The test was in the form of close passage and a short essay. Apart from that, the researcher has also distributed questionnaire and conducted an observation on the students' behaviors in class***. All in all, the results of the test show that the Experimental Group has indeed performed better than the Controlled Group.***

The evidence in the Malayan experiment is based on what is called ELL (English as a Second Language Learners). This evidence demonstrates that a game such as Vocabulary Fitness, which focuses on building math vocabulary along with basic skills, can promote more efficiency in a subject such as science than conventional instruction. All areas of learning have terms associated with the subject. This necessitates the tying in of those vocabulary terms with the basic skills.

Company Drill Game

Like Vocabulary Fitness, Company Drill also introduces a vocabulary review. But, because its subject is math, it focuses its approach on helping the student to review basic math skills. Company Drill takes an activity well known to educators called "*I Have, Who Has*?" and makes a highly competitive card game that allows students to hone their ability to solve math problems quickly by working as a team.

Speed Bag Game and Resources

The next game is a Science Boot Camp game called "Speed Bag". By its nature, this game stands alone and has no math equivalent.

There is more than one type of learning. The first recognized model of thinking, led by Benjamin Bloom, identified three domains of educational activities:

- **Cognitive**: mental skills (*Knowledge*)
- **Affective**: growth in feelings or emotional areas (*Attitude*)
- **Psychomotor**: manual or physical skills (*Skills*)

The more recent model of thinking skills, Marzano's Taxonomy provides a more in depth approach to understanding how students think by broadening the range of factors that affect a student's thinking.

Since the work was produced by higher education, the words tend to be a little bigger than we normally use. Domains can be thought of as categories. Trainers often refer to these three domains as KSA (Knowledge, Skills, and Attitude). This taxonomy of learning behaviors can be thought of as "the goals of the training process." That is, after the training session, the learner should have acquired new skills, knowledge, and/or attitudes.

Speed Bag first uses "psychomotor" or physical skills as the first component. This type of learning is generally characteristic of the "kinesthetic" learner. Of the seven categories of the psychomotor domain,

"guided response" is demonstrated through the illustration component of the game. Guided Response is interpreted as; "*The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing."*
The "dual coding theory of memory" (Pavio 1971) proposes that information is stored in long-term memory both as verbal propositions and as mental images. It suggests that when information is presented verbally *and* visually it has a better chance of being remembered. Thus, having the student compete with other students at drawing the concept represents the first step in what the creators of Speed Bag call, "*building a frame of reference"*.

After the illustration part of Speed Bag, there are four other components which address content knowledge, thought organization, assessment and critical thinking through extended response. The other components contained in the Speed Bag Student Work Booklet consist of, a reading passage, a graphic organizer or flow chart (which allows the student to organize the elements of each concept), a multiple choice question, and an extended response question. In the Speed Bag student work booklet, the student is also given another opportunity to illustrate the science concept again, but this time without the rushed competition. In fact, all of the components of Speed Bag are repeated a number of times throughout the game. This promotes personalized learning and reinforcement of the concept. The ability to express science concepts effectively rests on the students understanding of the process. Because Speed Bag addresses extended response from different angles, reaches each type of learner and builds the frame of reference.

Bench Press & Rock Climbing

We will now review the last two games called "**Bench Press**" (Science Boot Camp) and "**Rock Climbing"** (Math Boot Camp) which embed Science and Math Review into a Game Show.

Bench Press

Bench Press is a computer game. With its subject science, it is"Jeopardy"-like game, which again covers the four clusters that represent categories that the player can choose from at different point levels and different levels of difficulty. This game is review that encompasses 160 questions with self-checking answers.

During the ITE Teacher's Conference on reinforcing learning through game shows in 2003, it was determined that embedding a review in a game show has proven to be successful in increasing classroom motivation and interest, which can lead to increased testing aptitude. This is the purpose also the purpose of Math Boot Camp's "Rock Climbing" game.

Rock Climbing

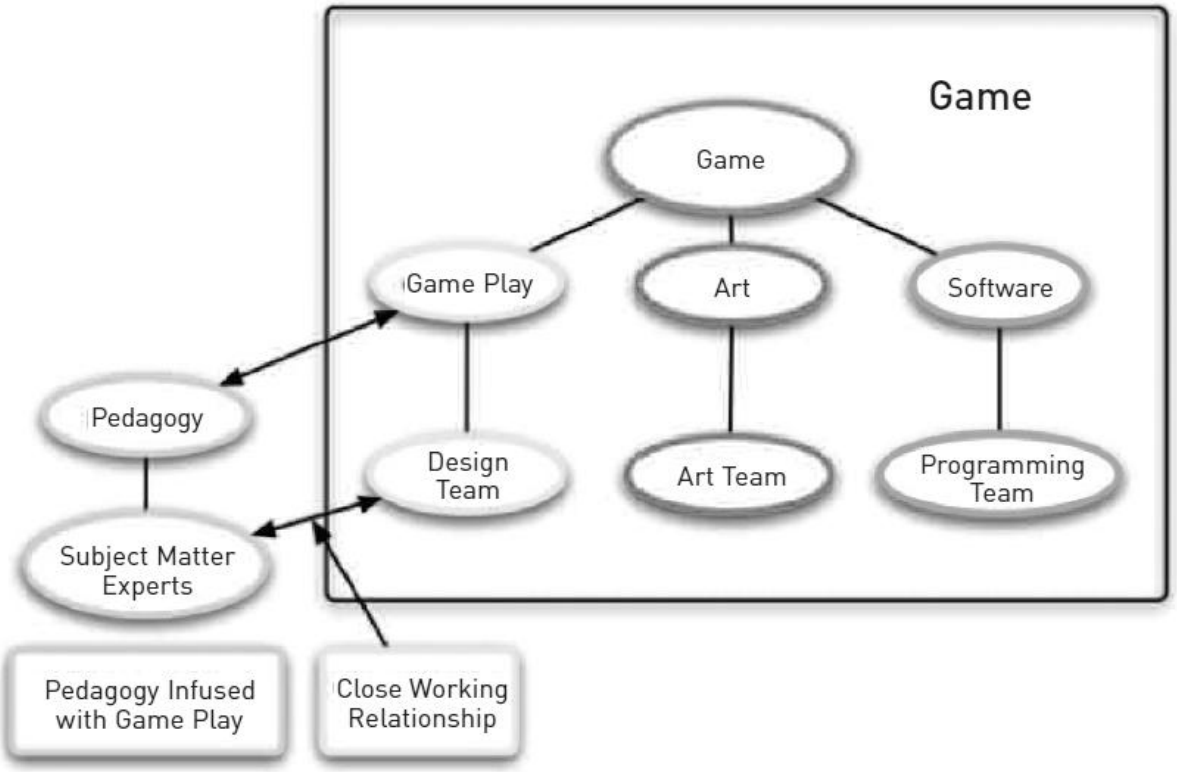
The Rock Climbing game is similar to Bench Press in that it also encompasses a math review embedded in a game show, the game show being similar to Jeopardy. Rock Climbing has 540 questions with self check answers. Rock Climbing's categories of play are based on the current NGSSS - Big Ideas 1, 2 and 3. This game can be used as a team challenge or as a benchmark review.

Designing learning activities for students have never been more challenging for teachers. Today, with technology being used in the classroom, these activities have demanded a different form of manifestation. One such activity is the review activity that is usually conducted at the end of the lesson. Bench Press and Rock Climbing introduce the game show element into the classroom. This method deviates from conventional lesson delivery and introduces a play element in the lesson. Playing games reinforces learning. This is a bold statement that some may dismiss as frivolous, but countless researchers and educational trainers have conducted extensive

studies and experiments to prove that games are one of the most powerful and successful ways to reinforce learning in students. When a game is introduced into a serious classroom environment, students relax, they get excited, they compete, and most importantly, they remember the event and the information tied to it.

The illustration below demonstrates how knowledge of pedagogy is integrated with the features of the game. In the case of the Boot Camp games, Bench Press & Rock Climbing, the pedagogy is the NGSSS Standards)

Embedding a review in a game show has proven to be successful in increasing classroom motivation, interest, which can lead to increased test aptitude.



Above illustration by: The Federation of American Scientists, www.fas.org.

Science "Foldables", "Mathables®" "Journaling" and the Science Boot Camp Labs

All of the above mentioned are the strategies used by the Science and Math Boot Camp interventions to target the areas "hands on", matching and sorting, thought organization, and critical thinking. Students in a hands-on science program remember the material better, feel a sense of accomplishment when the task is completed, and are able to transfer that experience easier to other learning situations. "When more than one method of learning is accessed as in hands-on learning, the information has a better chance of being stored in the memory for useful retrieval." *Perspectives of Hands-On Science Teaching", David L. Haury and Peter Rillero, 1994* Students who have difficulty in the learning arena for reasons of ESL barriers, auditory deficiencies, or behavioral interference can be found to be on task more often because they are *part of* the learning process and not just spectators.

Foldables are defined as a type of graphic organizers that students manipulate with their hands and minds. They are multi-dimensional. J & J Educational Boot Camp did not invent the Foldable concept. What its development team did is apply standardized content to various Foldable templates. This makes it easier for teachers as they only have to instruct the student on designing the foldable and then guide student participation through note-taking, illustrating, and identifying key words and or phrases as they relate to the content. Students are encouraged to collaborate on the creation of the Foldables and to work in pairs or small groups, as appropriate, as they pursue the assignment.

This strategy reinforces important skills central to both writing and problem-solving, such as brainstorming, analyzing, clarifying, and revising. It also provides a tool for both summative and formative assessment, fostering equity for all students**. "Mathables®**" are the Math Boot Camp version of the Science Foldables and therefore are essentially the same. With Mathables, students can make connections between disparate mathematical ideas and concepts. Mathables® are also useful in displaying a mathematics word bank of often-used words. Foldables provide a context for language for diverse learners with language gaps and for children for

whom English is a second language, thus giving students an opportunity to say their thought aloud before putting them in writing.. recording thoughts for students who have writing disabilities and encouraging them to read their words aloud**.**

When you use pieces that move, expand, fold, etc… Students will remember the way specific foldables work and use those to associate memories with content, increasing the likelihood of applying what they've learned.

Journaling

According to Nancy Frey, Ph.D., of San Diego University, "**Journaling**" foldables encourages meta-cognition through active learning. This strategy has also been found to foster, independent learning, reading comprehension, word solving and better understanding of text structures. This strategy also aids the student in comparing and contrasting. Journaling is also useful in organizing large amounts of information and categorizing. Both, Science Boot Camp and Math Boot Camp incorporate this strategy
Science Boot Camp Labs

"By actually doing and experiencing science, students develop their critical thinking skills as well as discover scientific concepts. This self discovery stays with students throughout their lifetimes while memory fades." *Carol J. Stadum, The Planetary Society (producers of Marslink teaching packets), Pasadena, CA*

Science Boot Camp's Labs are designed with the understanding that time allotment is a major concern in today's classrooms. Therefore, the experiments are designed to last between 20 to 30 minutes, leaving the teacher with adequate time to explore the data and question outcomes. The goal is to develop the concepts related to the Nature of Science cluster as designed by the State of Florida.

With the Science Boot Camp Lab experiments are three types of laboratory forms which allow the teacher to customize the learning experience based on the level and background of the group of students.
"The importance of providing children with direct experiences with materials, objects, and phenomena is supported by experience and understanding of how learning takes place. While information can be

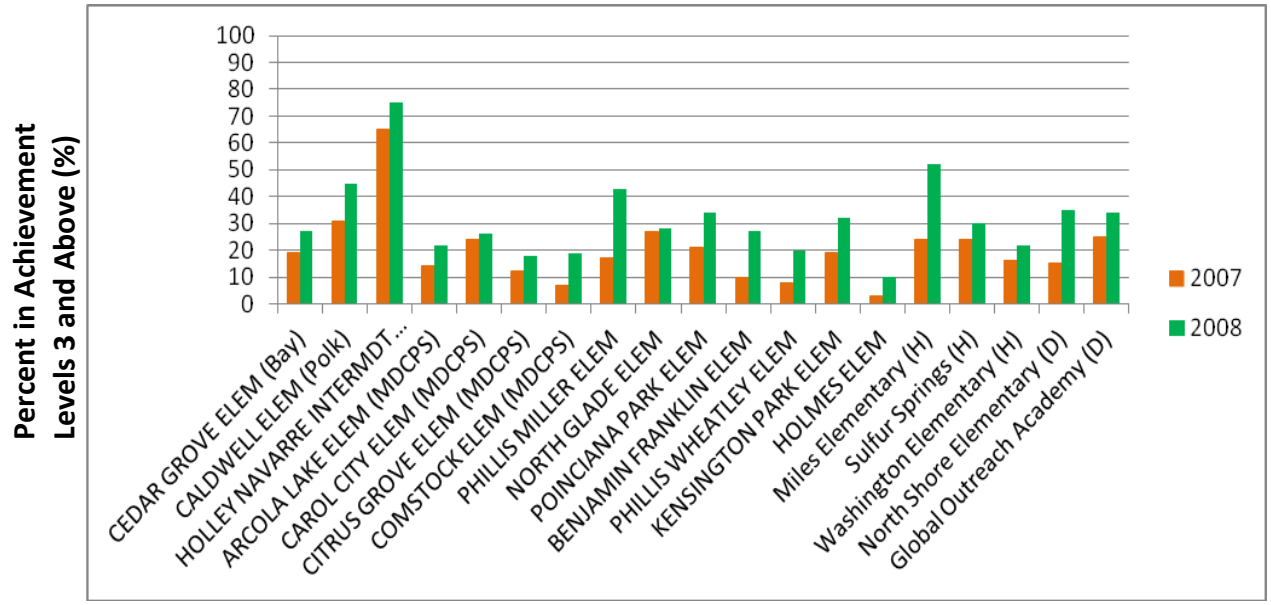
remembered if taught through books and lectures, true understanding and the ability to use knowledge in new situations requires learning in which children study concepts in-depth, and over time and learning that is founded in direct experience. Therefore, the justification for hands-on learning is that it allows students to build understanding that is functional and to develop the ability to inquire themselves, in other words, to become independent learners." *Karen Worth, Education Development Center, Inc. (Developers of Insights: A 1), Newton, MA*

Conclusion & Results

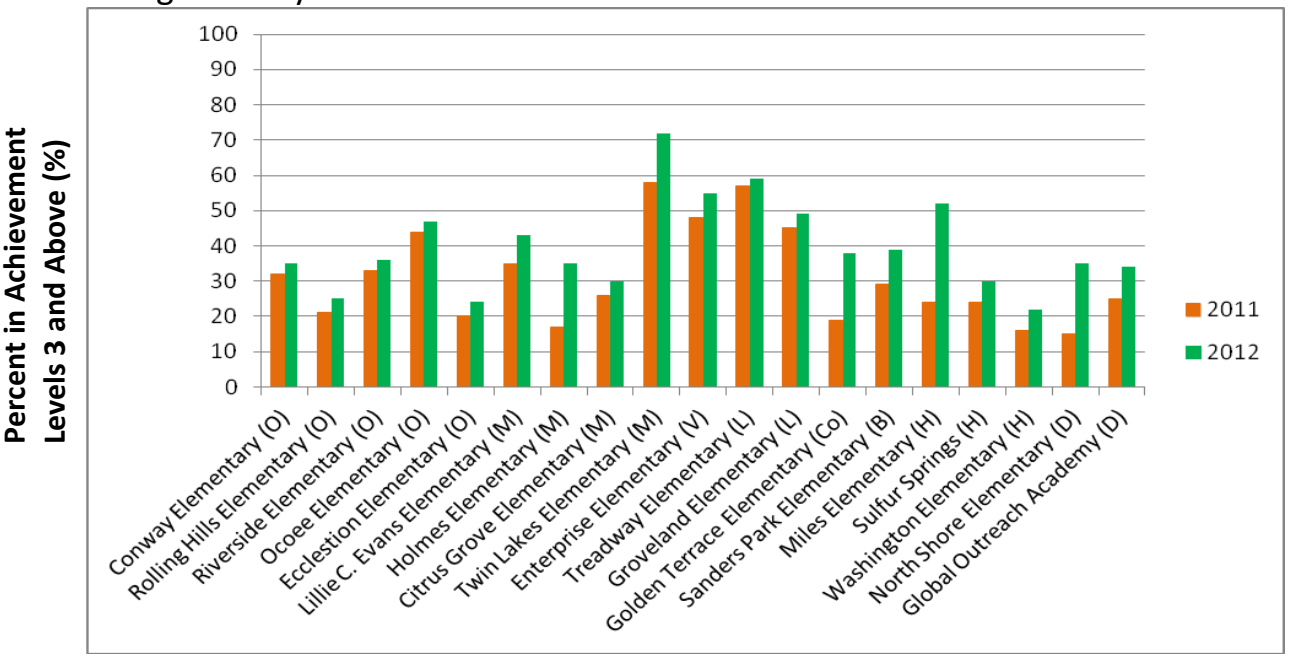
Compared to conventional instruction, do the Science and Math Boot Camp games provide a more positive "response to intervention" (RTI)?
The answer is YES, simply because Science Boot Camp games work where conventional instruction hasn't. Although Math Boot Camp is still in the development stages, Science Boot Camp has two years of data with schools in the State of Florida that prove its claim. In fact, many schools that utilize Science Boot Camp say that the Science Boot Camp intervention has replaced conventional instruction.

Can the Science Boot Camp and Math Boot Camp games increase aptitude in standardized testing?

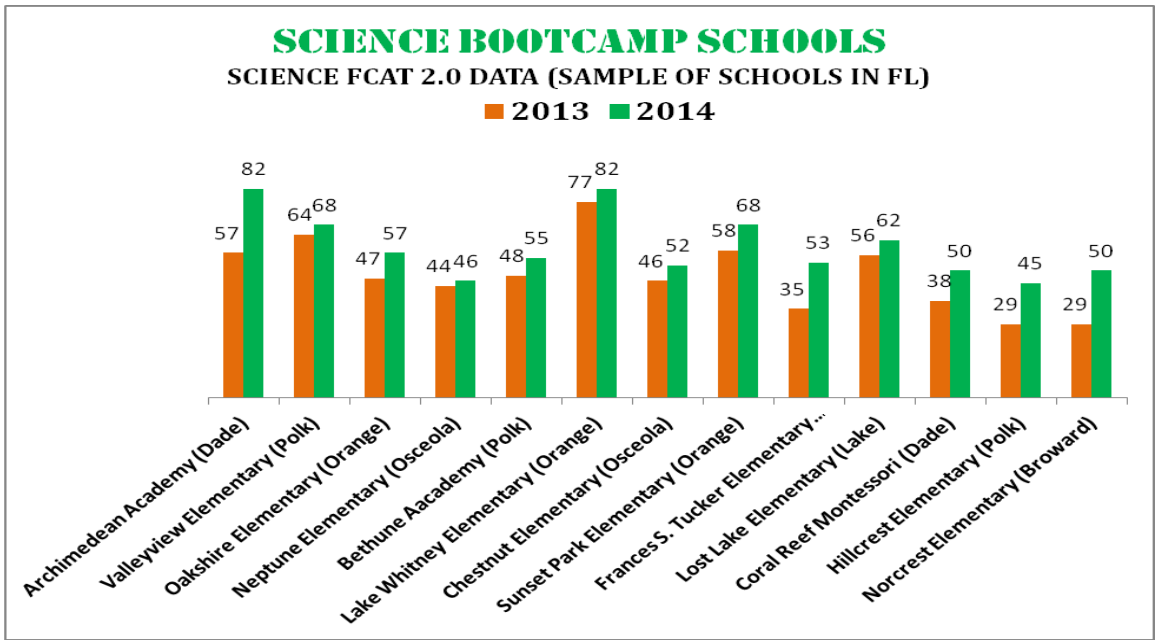
Following is a composite of schools from Miami Dade County, Florida that used the Science Boot Camp intervention in the school years 2006 and 2007. The chart shows dramatic increases in science scores from the previous year.



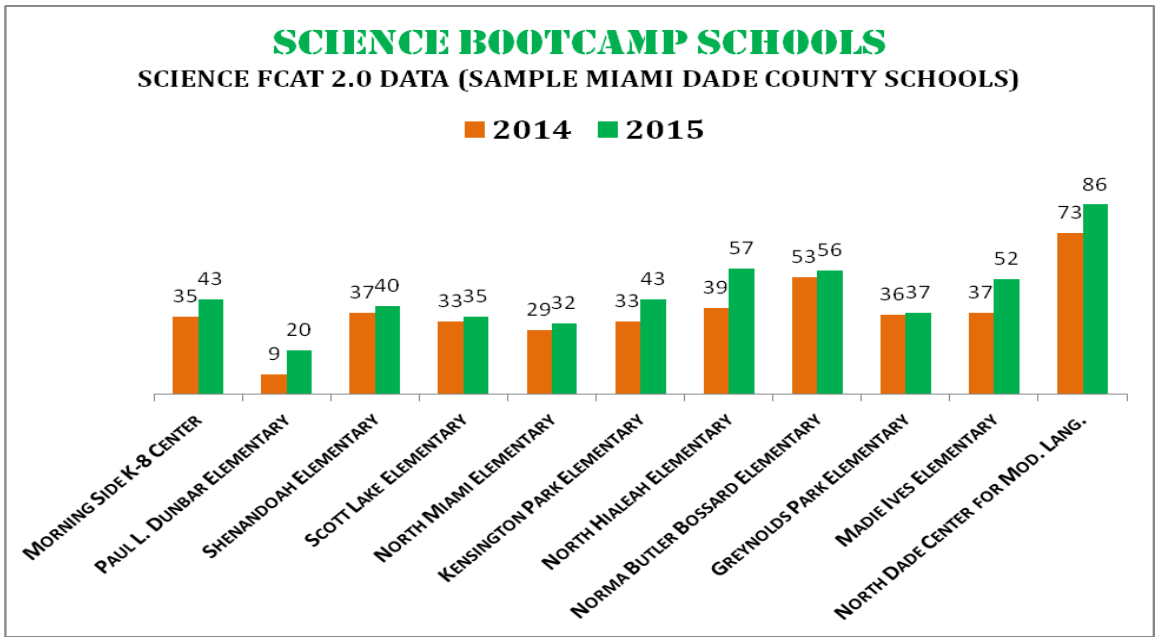
Additional School Data for Specific Counties have been added below:
Orange County 2011 - 2012



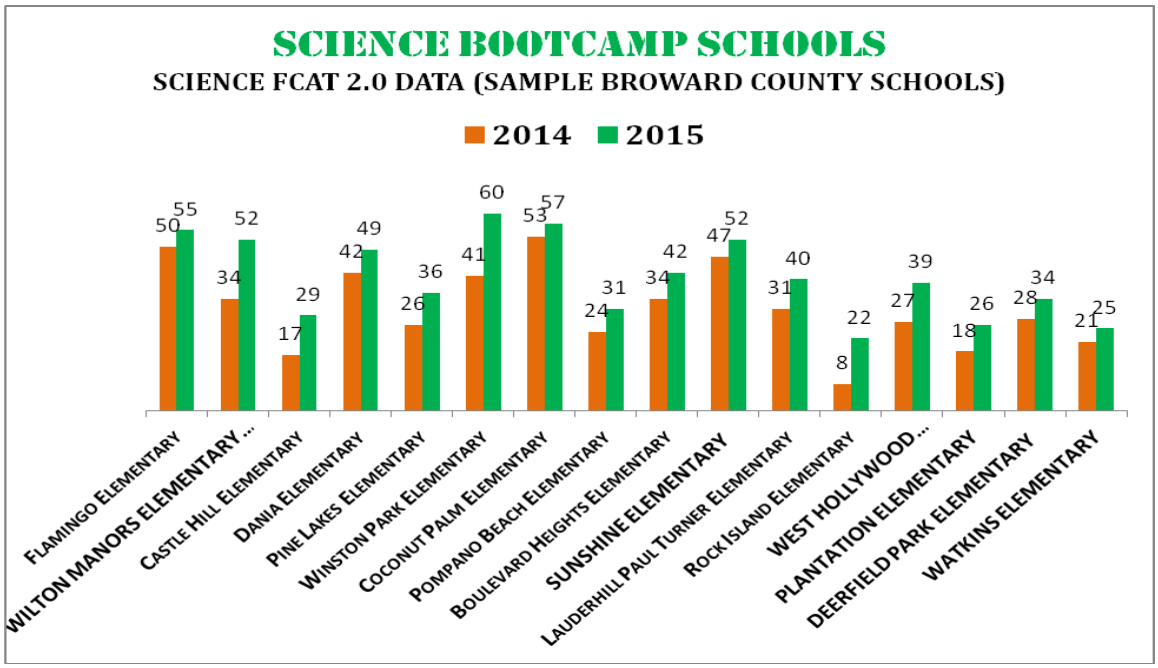
Additional School Data for Various Counties throughout Florida have been added below2013 - 2014:



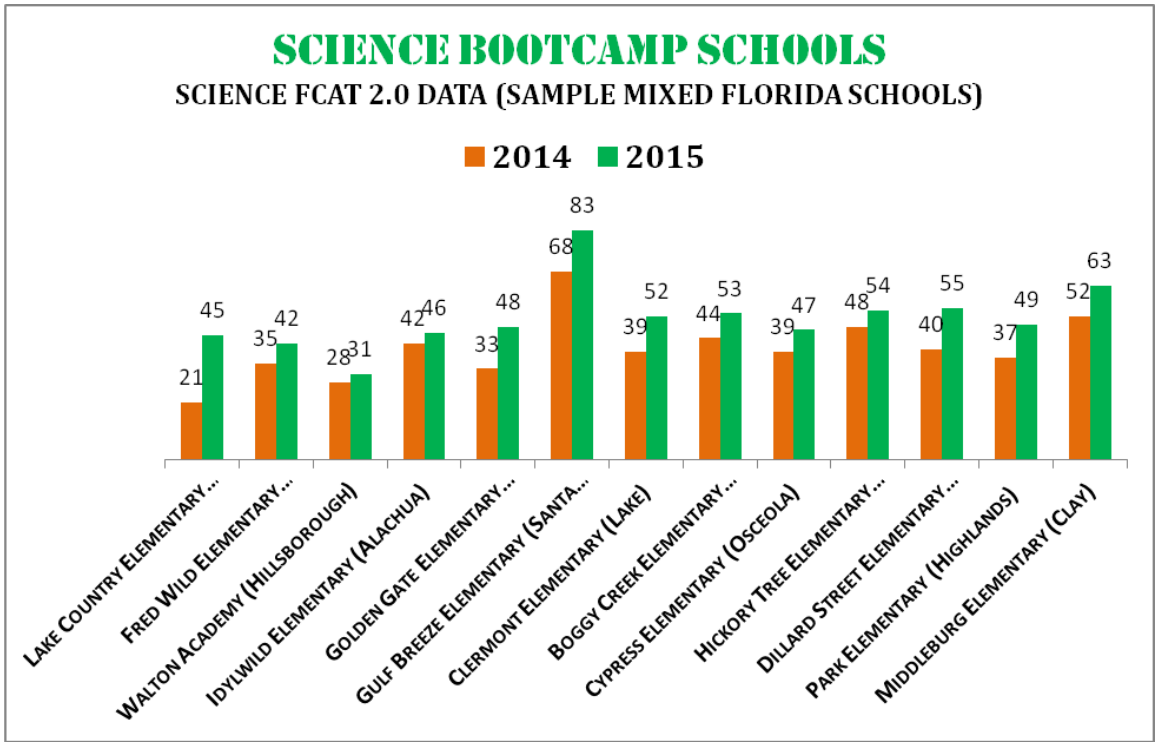
Additional School Data for Miami Dade County Public Schools have been added below 2014 - 2015:



Additional School Data for Broward County Public Schools have been added below 2014 - 2015:



Additional School Data for Various Counties throughout Florida have been added below2014 - 2015:



By combining the element of game play, with other non- traditional "Boot Camp Strategies), are the Science and Math Boot Camp resources a more effective means of intervention than conventional methods?

The evidence shows that Science Boot Camp can and has increased science testing aptitude and thus Science Boot Camp Games also provide a more positive response to RTI. Math Boot Camp, at the time of this writing is currently in the development stages. It is modeled on the Science Boot Camp example and its developers are sure that Math Boot Camp will be just as successful at increasing testing aptitude. Probably the biggest contributor to the success of Science Boot Camp and the eventual success of Math Boot Camp is the fact that both intervention platforms lessen the teacher's preparation time. With everything from standard aligned content to structured group activities to built in maintenance; most of the preparation work that an instructor would normally have to do is already done and provided by Science and Math Boot Camp. According to experts at the University of Alberta, (California), when a plan is prepared, the teacher's cognitive load is less and they can pay more attention to other aspects of the learning process. Teaching is a stressful job, and Science and Math Boot Camp interventions really lighten a teacher's load. All of the components of these interventions work to target each type of learner and this is why these interventions are more effective than traditional methods of teaching.

J & J Educational Boot Camp asserts that both Science Boot Camp and Math Boot Camp interventions will continue to increase class motivation, excitement and most of all, the love of math & science.
As the experts agree, entertained students learn more!

Appendix

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