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The Student and School Benefits of Penda

Efficacy Study on Outcomes of Student-Driven Learning in High Schools: From Remediation to Enrichment for Math and Science

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1.0 Summary

Penda's test preparation web-enabled programs in Math and Science are being used enthusiastically and successfully by teachers and students in American high schools and by more than a million students in five other countries. The *Penda* content brackets all users from remedial to enrichment and enhancement. More than half the course work that students completed in Math and Science was at the advanced level. Students liked *Penda* so much that 49% of their use was outside of school hours, an investment that powers their learning and that frees up time from the overcrowded curriculum of the school!

Penda has several advantages for secondary students and educators. We examined the results from a large-scale deployment by Florida's Orange County Public Schools (OCPS). There are statistically significant relationships between a student's use of *Penda* and their subsequent FCAT test performance in both Science and Math. That help to students runs across the topics in the Florida high stakes "Science" test – Chemistry, Biology and Physics. Second, OCPS students liked *Penda* so much that they used it after school and that practice was also related to FCAT performance. The amount of *Penda* use is related to FCAT scores. In Physics, for example, each additional *Penda* Physics exercise completed was related to a 3.6 point increase in Science FCAT scores. Thus, a student who completed 10 exercises could expect a 36 point gain on the FCAT scale score range (from 100-500).

These positive results are more remarkable because they are coming from the schools' most needy students – students who have not typically achieved academically but who need extra help to graduate. It is also remarkable that *Penda* is helping students in curriculum topics where high schools have trouble attracting qualified teachers – math and science. Orange County schools enroll 13,500 high school students and used *Penda* to improve the odds that students would succeed at the Florida's high stakes high school exit exam. That deployment indicates the benefits of this curriculum for large scale use.

Interactive, Inc. examined records from more than 8,000 *Penda* users across the United States. *Penda* coursework was graded on a 100-point maximum scale. The average of all Math items completed correctly, for example, was 79%. The high proportion of correct answers on the test prep units along with the visual nature and fast pace of the materials help explain student progress and persistence.

Table 1: Correct Student Responses by *Penda* Curriculum Topic: Summary Mean Percents Correct within Related Exercises (Most to least successful)	
Math	79.0%
Science	77.4%
Chemistry	76.8%
Physics	72.5%
Biology	70.9%

One school administrator remarked that, after they began using *Penda*, the number of students who did not graduate from high school dropped by half. Another school planned to deploy it as intensive preparation for the state exams but only in the second quarter. As the teachers discovered its uses and saw how much the students liked it, they continued the program through the rest of the school year. A third school organized the day into 50-minute blocks but found that the 'research block' was a problem. Students were bored. The conventional remedy of assigning extra teachers was blocked by staff cuts. When that school added *Penda* as the chief Math and Science application for the 'research block', student enthusiasm replaced student apathy and without extra staff.

Veteran administrators remarked that *Penda* was the only curriculum in their careers that had never drawn any teacher complaints. The administrators said they would use *Penda* 'from Day One' and across all the targeted curriculum subjects.

Interactive, Inc. is a "gold standard" education program evaluation firm listed on the US Department of Education's *Registry of Outcomes Evaluators.* This third-party analysis was supported by *Penda* but was otherwise independent of the Company.

2.0 From Remediation to Enrichment: The Need for *Penda*

American schools have too many goals and too few resources. Teachers especially are over-loaded with clerical tasks, counseling responsibilities and discipline problems on top of demands for subject matter mastery and teaching that is supposed to be vivid and compelling. One way to summarize that goal overload---from remediation to enrichment---also describes the range of learning needs in most classrooms. Despite their best efforts, teachers are going too fast for some students and too slow for others.

Most teachers are teaching just as hard as they can. Fortunately, there are ways to help both teachers and students be more successful even with the wide array of different student and learning needs and styles. *Penda*'s resources bracket those student needs. For example, more than half (52%) of the exercises completed in 2009 by 58,000 students were at the "Advanced" level.

Consider also the pandemic problem of high school dropouts. Federal statistics indicate that failing a grade increases the prospect that student will drop out of school by a factor of five (NCES, 2008). High school dropouts are three times more likely to be unemployed than college graduates and, compared just to others who will graduate from high school (only), the earnings of dropouts will be $9,200 less every year ![1] (Bb/Blackboard K-12, 2009) Research suggests that ninth grade is critical in predicting whether a student stays in school or not (Neild, 2008). And early failure compounds the grim prospect of later failure (Roderick and Camburn, 1999). Still, many students fail to graduate, not because of chronic low grades but because they lack a few credits. They could easily benefit from practice skills but they are discouraged by their previous lack of success and their teachers are distracted by other priorities.

Low performers are not the only students disserved by the general pace and organization of classroom teaching. What is too fast for some is too slow for others, where some students need repetition and re-teaching other students need enrichment and a chance to learn on their own. Young people at both ends of the learning spectrum are interested in doing well on tests. High achieving students, too, want practice opportunities and/or something that goes beyond their classroom, something that enriches or enhances their learning. The *Penda* gate to higher achievement swings open for both groups of students.

Bridgeland (2006) documents that high school students want more help, more capable teaching and smaller learning environments. Those understandable improvements are hard to afford in conventional classrooms but easily within the reach of well-designed digital learning applications.

3.0 How *Penda* Works

Penda's web-enabled curriculums help all students do better on high school exit exams and other assessments. Kids and their teachers recognize most exam prep software for what it is, "drill and kill" – unimaginative, repetitive, boring, ineffectual and sometimes counter-productive. *Penda* is different in two important ways. First, it is student-driven and second, it is scaffolded to reward success and motivate further learning.

Student-driven. Why is 'student-driven' important? First, if someone is trying to catch up in a topic, it is likely that they have not had much previous success. Controlling their own experience is an opportunity to dictate the pace, experience success and if necessary try, try again – in private and without embarrassment. Where students are controlling their own experience and being successful, teachers don't have

[1] Young people are not the only ones impacted by dropping out of school. Dropouts from the national class of 2008, will cost the US $319 billion over their lifetimes (Bb/Blackboard K-12, 2009).

to be frustrated and neither they nor the students will experience resistance, resentment. Rather, if the engagement is compelling and successful, the student's experience is an incentive to learn more.

Scaffolded. *Penda* is organized into exercises of about ten minutes and those units are presented in an order of increasing challenge ("foundation" to "intermediate" to "advanced"). Expectations for student performance are determined by the student's reading level and by the content of the topic. Said differently, *Penda*'s content is not dumbed down, it is authentic, appropriate and interesting. The combination of bite-sized and success-oriented chunks is both popular with learners (see 5.0 "How Students Use *Penda*", below) and good pedagogy[2]. As one 11th grader at New York City's DeWitt Clinton high school put it, "The program broke stuff down in pieces I could get, helped me learn them, and then helped me put them back together again." All of *Penda*'s math course work is keyed to the standards of the states in which these students were enrolled.

Table 2: Numbers of *Penda* exercises aligned to state standards	
New York	343
California	310
Florida	307

Teachers like that alignment because it targets their lessons on things that will be tested. And, for the same reason, it advances student success on subsequent tests all of which are linked to standards.

Additional *Penda* features. High school teachers typically work with a hundred or more students every day. In the face of that inundation, most teachers default to whole class instruction. *Penda* is designed so that the teachers introduce it and the students drive it. That frees teachers for other tasks and it maximizes student participation, ownership and pride in outcomes.

Penda's learning management system functionality is unusually graphic. The data on student interaction with the system – what was attempted, how well it worked, how that accomplishment was related to standards – are all a mouse click away and graphically presented so that teachers know what they should do next. With *Penda*, teachers can follow automatically generated progress reports and create any kind of student group. *Penda* automatically populates monthly summaries by school, by subject and by student. That is more than an accounting function. As classroom instruction is forced to become more evidence-based, the system's feedback and reporting capabilities

[2] Vygotsky (1997) emphasized that learning is maximized when objectives are "high but attainable". This is a 'Goldilocks phenomenon': "high but attainable" is just right between too demanding and too forgiving both of which discourage investment. The "high but attainable" principle reinforces effort and encourages persistence.

reduce clerical work and make teaching more precise and more successful. As one put it, "I can see who's doing what".

Jorgensen (2009) summarizes these capabilities:

> *Penda* is a student-driven system of assessment and instruction that provides content in mathematics and science along a range of complexity including even the most rigorous of high school subjects. … (B)ecause the content is aligned to state standards, teachers can monitor progress towards grade- level proficiency.

In the next section, we discuss how *Penda* is organized and then review the data that document student engagement and enthusiasm. The table below displays the components of the curriculum.

Table 3:
***Penda* Course Organization by Curriculum Subject, by Number of Topics and Number of Exercises**

Subject	# of topics	# of exercises (subtopics)
Math	12	193
Science	16	80
Chemistry	18	74
Physics	10	30
Biology	15	46
Total:	**71**	**423**

Topics and exercises for Chemistry, Physics and Biology are all at the "Advanced" level. Science exercises are either "Intermediate" or "Foundation" and Math exercises are at all three levels, "Advanced", "Intermediate" or "Foundation".

4.0 *Penda* and Student Success in Florida's Orange County Public Schools

High schools in the Orange County Public Schools (OCPS) used the science and math curriculums from *Penda* to help students get ready to take Florida's Comprehensive Assessment Test, the FCAT. Florida was an early adopter of statewide "high stakes" testing to determine the eligibility of students to graduate from high school. The sections that follow describe the relation between students' use of *Penda* and their performance on the FCAT.

Penda has stocks of student exercises in curriculum topics, sub-topics and detailed objectives. The array of available exercises is more finely grained than the more general descriptions in state learning standards. *Penda* material has been aligned to the "Sunshine State Standards" (the Florida state requirements). In the analyses below, we search for relations between student performance on *Penda* items that had been aligned to the state standards and the same student's subsequent performance on the FCAT scaled scores (range from 100 to 500). We used R^2 to measure the amount of variability in FCAT scores explained by the variability in *Penda* scores. Additionally,

regression analyses were used to estimate values of FCAT scores in Math and Science from predictors of student success with Penda.

4.1 *Penda* and FCAT science performance Schools seeking a way to help students prepare for the high school exit exams ask, is there a relation between the test preparation materials and the FCAT score? For *Penda*, the answer is "Yes". There are statistically significant relationships between a student's use of *Penda* in Chemistry, in Biology and in Physics and their subsequent scores on the Florida Comprehensive Assessment Test of Science.

For OCPS students who had the benefit of *Penda* test preparation, their FCAT scaled scores for Science are positively correlated with the average score correct for *Penda* exercises in Chemistry, Biology and Physics. Second, there is a relation between the number of *Penda* Chemistry, Biology and Physics exercises completed and their FCAT performance. Third, for Biology and Physics, work with *Penda* after school or at home is related to FCAT scores.

The table below documents an association between students using *Penda* more and doing better on the FCAT. For example, the average score for Penda Chemistry exercises accounts for about 18% of the variance in FCAT scaled Science scores.

Table 4:
Orange County Public School Student
FCAT Science Scaled Scores Related to
***Penda* Science Test Preparation Subjects and Scores**
(Chemistry, Biology and Physics)

	Pearson correlation	R^2	Significance	n
Chemistry				
Average score for Chemistry exercises	.420	.176	<.001	819
Number of *Penda* Chemistry exercises completed	.128	.016	< .001	819
Biology				
Average score for Biology exercises	.276	.076	<.001	669
Number of *Penda* Biology exercises completed	.196	.038	<.001	669
Number of Biology exercises completed after school hours	.126	.016	<.05	321
Physics				
Number of *Penda* Physics exercises completed	.238	.057	<.001	561
Average score for Physics exercises	.189	.035	<.001	561
Number of Physics exercises completed after school hours	.119	.014	<.05	273

Penda Chemistry and FCAT Science. Together, the average score for Penda Chemistry exercises and the number of *Penda* Chemistry exercises completed by students are predictive of 18.3% of the variance in FCAT scaled scores for Science. For each additional Chemistry exercise completed, there is a 0.74 point increase in Science FCAT scores and for each one point increase in the average score for Penda Chemistry exercises, there is a 1.2 point increase in Science FCAT scores.

Penda Physics and FCAT Science. Together, the average score for Penda Physics exercises and the number of *Penda* Physics exercises completed by students are predictive of 9.7% of the variance in FCAT scaled scores for Science. For each additional Physics exercise completed, there is a 3.64 point increase in Science FCAT scores and for each one point increase in the average score for Penda Physics exercises, there is a 0.64 point increase in Science FCAT scores. Thus, the average student who completed 10 *Penda* exercises[3] could expect to move up 36 points on the FCAT Science test.

Penda Biology and FCAT Science. Together, the average score for *Penda* Biology exercises and the number of Penda Biology exercises completed by students are predictive of 10.6% of the variance in FCAT scaled scores for Science. For each additional Biology exercise completed, there is a 2.2 point increase in Science FCAT scores and for each one point increase in the average score for Penda Biology exercises, there is a 0.82 point increase in Science FCAT scores.

4.2 *Penda* and FCAT math performance

FCAT scaled scores for Math are positively correlated with: (1) the average score for *Penda* Math exercises; (2) the number of *Penda* Math exercises completed and (3) the number of *Penda* Math exercises completed outside of school hours.

The willingness of students to use *Penda* Math at home and after school was remarkable.

[3] *Penda* exercises include 10-15 questions and are designed to be completed in approximately 10 minutes.

Table 5: Orange County Public School Student FCAT Math Scaled Scores Related to *Penda* Math Test Preparation Scores				
	Pearson correlation (R)	R^2	Significance	n
Average score for *Penda* Math exercises	.529	.279	< .001	1348
Number of *Penda* Math exercises completed outside of school hours	.224	.050	< .001	658
Number of *Penda* Math exercises completed	.097	.009	< .001	1348

The average score for *Penda* exercises in Math accounts for 28% of the variance in FCAT scaled scores in Math.

Together, the average score for *Penda* Math exercises and the number of Penda Math exercises completed by students are predictive of 28.1% of the variance in FCAT scaled scores for Math. For each additional Math exercise completed, there is a 0.01 point increase in Math FCAT scores and for each one point increase in the average score for Penda Math exercises, there is a 1.33 point increase in Math FCAT scores.

4.3 *Penda* and Florida public schools

The achievement environment in Florida high schools is captured by a headline in the St. Petersburg *Times*, "School grades plummet statewide and around the bay area" (Matus, 2009). End-of-year test scores dropped in 64% of the area's high schools: in 4% of the schools, they got better. Of all the schools in the state, only 23% made adequate yearly progress. At the same time, budget cuts slashed special programs. One county cut 63 reading coaches. With fewer teachers, the only path to more success is more technology. The former chancellor of Florida's public school system, Jim Warford said, "Kids don't get more stupid or less capable in high school. It's just not relevant to them. These are iPhone kids. Our schools are still chalkboard worlds." (Matus, 2009)

Penda has several advantages for secondary educators and their students. First, there are statistically significant relationships between a student's use of *Penda* and their subsequent FCAT test performance in both Science and Math. That helps runs across the topics in the Florida "Science" test – Chemistry, Biology and Physics. Second, students like *Penda* so much that they use it after school and that use is also related to FCAT performance. Third, there is a relationship between the amount of *Penda* use and FCAT scores. In Physics, for each one point increase in the number of *Penda* Physics exercises completed, there is a 3.6 point increase in SCIENCE FCAT scores.

These positive results are more remarkable because they are coming from the system's most needy students, those that have not typically done well at school but who need

extra help to graduate. It is also remarkable that *Penda* is helping students in curriculum topics where high schools have trouble attracting qualified teachers – math and science.

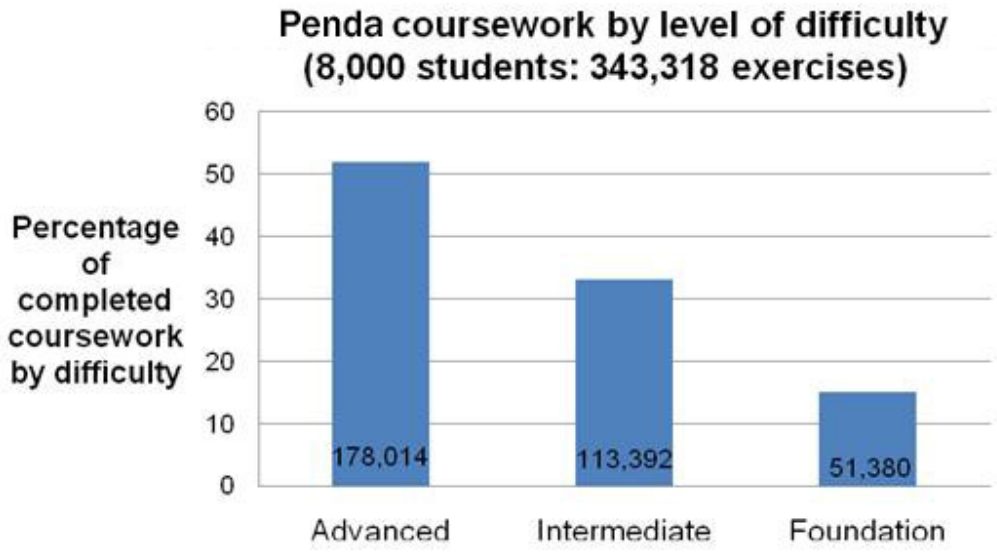
5.0 How Students Used *Penda*

The participation hypothesis says that as involvement increases, learning increases: the importance of active learning grows from that relationship. In *How People Learn: Brain, Mind, Experience and School*, Donovan and Bransford (2005) emphasize the centrality of students controlling their own learning and, because of that control, maximizing their progress.

It is not possible to overstate the importance of students actually using learning materials. From the perspective of schools, owning a piece of software is no help unless it is used. Decades of implementation experience document that the most likely explanation for no or low results is no or low use. From the student's perspective, "Not fun = not done", a statement that might be called "The Rule of Homework". *Penda* has been systematically designed to engage students, to reward them with success and to motivate additional learning.

In 2008 and 2009, about 8,000 students completed 343,318 *Penda* exercises and the majority of those were at the most demanding, "Advanced" level (see next graph).

Figure 1:



Overall measures of student success[4]

[4] Data for tables 6 – 11 come from *Penda* records of student use in Florida, New York and California.

The summary table below confirms the 'success orientation' of *Penda*'s material. Recall that the curriculum strategy is to encourage further learning by rewarding prior learning. The table below shows the results of *Penda*'s consistently "high but attainable" materials. The pattern documented in the table below is more remarkable when it is recalled that there is more *Penda* use at the advanced level and that these are topics – math and science – that are hard-to-staff in public schools. Coursework was graded on a 100-point maximum scale. The average of all Math items completed correctly, for example, was 79%.

Table 6: Correct Student Responses by *Penda* Curriculum Topic: Summary Mean Percents Correct within Related Exercises (Most to least successful)	
Math	79.0%
Science	77.4%
Chemistry	76.8%
Physics	72.5%
Biology	70.9%

Measures of student success by Math and Science curriculum topics

The next tables show from most-to-least how well the students did with the exercises and particular subtopics within *Penda* curriculum groups. For example, within Chemistry, 85% of the questions within the subtopic "Ions in solution" were answered correctly as were 79% of the "Polymers" questions.

Table 7: Math: Mean score percents correct from most-to-least			
Topic	**Mean % correct**	**Std. Dev.**	**N**
1. Paper And Pencil Methods	87.14*	21.7	2304
2. Fractions, Decimals And Percentages	85.09	19.0	3624
3. Mental Strategies	84.64	23.5	1481
4. Place Value, Ordering And Rounding	82.22	24.9	1819
5. Geometry	81.53	27.5	45152
6. Algebra	76.90	28.4	49010
7. Using A Calculator	79.39	20.8	1111
8. Data Analysis	78.98	24.7	3920
9. Data Analysis and Probability	78.62	31.3	18009
10. Number Properties	78.51	32.0	1776
11. Number and Operations	77.60	30.0	23096
12. Measurement	77.36	27.0	19392

*Table Note: The mean scores represent the average percent correct for all students completing exercises within each *Penda* topic listed.

Table 8: Science: Mean score percents correct from most-to-least			
Topic	**Mean % correct**	**Std. Dev.**	**N**
1. Life Processes and Living Things	86.53	18.4	8977
2. Living Things In The Environment	83.03	29.3	4963
3. Materials and their Properties	81.26	23.1	11475
4. Light And Sound	80.80	22.7	2392
5. Energy Resources	80.66	23.0	3123
6. Variation, Classification and Inheritance	79.33	31.0	2698
7. Classifying Materials	78.94	27.4	8365
8. Forces And Motion	78.14	25.8	6083
9. Electricity And Magnetism	76.04	27.6	5987
10. Humans As Organisms	74.80	24.6	4384
11. The Earth And Beyond	73.63	27.9	1648
12. Life Processes And Cell Activity	73.07	21.4	1310
13. Physical Processes	71.21	30.8	7631
14. Changing Materials	70.41	26.0	6314
15. Patterns Of Behavior	67.02	35.6	1538
16. Green Plants As Organisms	63.87	36.0	4007

Table 9: Chemistry: Mean score percents correct from most-to-least			
Topic	**Mean % correct**	**Std. Dev.**	**N**
1. Titrations	89.62	22.0	329
2. Solubility	89.58	16.7	386
3. Energy Changes	86.33	22.0	245
4. Chemical Energetics	86.07	22.0	251
5. Ions in Solution	84.87	22.4	559
6. Hard Water	84.60	23.0	440
7. Metals	81.25	27.1	531
8. Chemical Analysis	79.54	27.0	630
9. Rates of Reaction	79.42	23.4	1271
10. Plant Oils	79.12	31.0	650

11. Earth and Atmosphere	78.92	22.0	4226
12. Polymers	78.65	30.3	481
13. Acids and Bases	78.54	24.1	1238
14. Chemical Calculations	75.71	30.0	3210
15. Structure and Bonding	74.58	30.0	2777
16. Building Materials	74.50	28.1	5488
17. Periodic Table	73.72	24.0	3922
18. Structure and Properties	71.58	33.7	1967

Table 10:
Physics: Mean score correct percents correct from most-to-least

Topic	Mean % correct	Std. Dev.	N
1. Turning Effects of Forces	80.18	26.2	1186
2. Energy and Electricity	78.95	26.0	1944
3. Space	77.60	20.8	1689
4. Light and Sound	77.53	26.7	820
5. How Science Works	76.49	33.3	4590
6. Electricity	72.86	33.8	1177
7. Nuclear Physics	72.00	31.7	1195
8. Electricity and Magnetism	71.93	26.4	1341
9. Motion	68.22	37.4	4849
10. Radiation and the Universe	61.50	40.5	2819

Table 11:
Biology: Mean score percents correct from most-to-least

Topic	Mean % correct	Std. Dev.	N
1. Inheritance	79.12	24.5	7001
2. Enzymes and their Functions	75.65	27.2	1754
3. Plant Nutrition	74.25	28.8	1471
4. Exchange of Materials – Plant	74.19	33.7	652
5. Evolution and Adaptation	74.01	27.4	4321
6. Food Chains	73.32	25.9	4397
7. Ecology	72.64	29.0	1887
8. Homeostasis	72.24	34.9	2528
9. Health	67.11	34.7	800
10. Drugs	66.96	39.1	2657

11. Microorganisms	66.17	41.2	1553
12. Exchange of Materials – Animal	65.61	39.8	1512
13. Transport around the Body	65.12	36.8	2908
14. Cells	63.72	34.6	3482
15. Bodies Response to Change	54.28	42.4	1995

One Florida educator pointed out that student behavior problems begin when students fail at school tasks. "Kids who are more successful at reading, are less frustrated with being in school. *Penda* made them successful and success reduces frustration."

Where and when students worked with *Penda*. Forty-nine percent of *Penda* use was outside of school hours! That after school, at home, "on their own time" use is very unusual. A Florida assistant principal said that half his students' *Penda* use was in school and half at home. He said, "That wouldn't happen if they didn't like it and if they hadn't concluded that *Penda* made them more successful in school."

6.0 School Leaders and *Penda*

Running high schools has been described as an impossible job masquerading as a wonderful opportunity. Given the tough circumstances of making school work for teen-agers, the unanimity of support for *Penda* from high school administrators is remarkable. We interviewed principals, assistant principals, program directors and teacher leaders. They had all had experience with other, standards-based software programs and they all praised *Penda*.

6.1 Florida educators

Florida schools used *Penda* in a variety of environments---during and after school hours, during the regular school year and in summer school. The range of learners in one Florida high school that has adopted *Penda* is typical. This magnet school features technology career training. The enrollment profile is bi-modal – at one end, some students are planning to be engineers and doctors. At the other end, some students have recently arrived from countries where they had no schooling and are illiterate in two languages. The problems of the high-needs students are well known but the school also has problems with the high-aspiring students. Those students take biology in the 10th grade, but the state tests it in the 11th grade and by then the students have forgotten much of what they once knew. The school was looking for a test preparation service that was sufficiently flexible and sufficiently powerful to serve as both remediation and review, both remediation and enrichment.

One school administrator remarked that, after they began using *Penda*, the number of students who did not graduate from high school dropped by half. Another school planned to deploy it as intensive preparation for the state exams but only in the second

quarter. As the teachers discovered its uses and saw how much the students liked it, they continued the program through the rest of the school year.

Another school organized the day into 50-minute blocks but found that the 'research block' was a problem. Students were bored. The conventional remedy of assigning extra teachers, extra mentors and tutors was blocked by staff cuts. When that school added *Penda* as the chief Math and Science application for the 'research block', student enthusiasm replaced student apathy and without extra staff.

Penda has been designed for ease of use by teachers and by students. A science supervisor said that all her teachers had to do was "log in and go to the science portion". After that, teachers quickly understood that they could use it for quizzes, for preparation or 'advance organizers' (student work prior to class), for review, for vocabulary, for writing. Most curriculum software directs students to make selections among fixed menus of options. *Penda* goes beyond that and both teachers and students liked the writing assignments that were embedded in the science materials. The feature allows science teachers to extend the capability that they create in their students to writing skills and, because those too are tested, that was a welcome addition.

Teachers particularly appreciated the 'thinking maps'. Another school introduced *Penda* to the science department teachers but the math teachers learned about it, tried it and adopted it without any professional development. Another administrator found that after showing teachers the system for 5 to 10 minutes, they could take it over, navigate the features and use it independently.

Because *Penda* is online, teachers could, if they wished, organize competitions among students, between classes and even between schools. Some teachers credited competition with motivating students to push farther into the program.

Florida followed its imposition of statewide exit exams with the availability of a free test preparation resource. While it has been helpful, it is also now widely regarded as too limited. "My kids were tired of looking at the 'same-old, same-old' stuff. Whatever they did, it always returned them to the same low-level skills and screens. It may be free but it is also boring. Seventy-five percent of my students like *Penda* and think it's easy to use" (from a county school administrator). Another principal said of the state's free software program, "It's not set up for growth." A third administrator compared the state's free service to *Penda* and said, "It's five times better for both Math and Science."

One assistant principal said, "There's too much FCAT preparation that is too narrow. *Penda* is perfect to enrich summer school. It's an excellent tool for student learning."

Demands on teacher time are notorious and have gotten more intense with the expectation that they will work less as solo-practitioners (the "egg-crate" school where each teacher is isolated in a self-contained classroom) and more as collegial teams. The problem is that teamwork takes planning and planning takes time. One principal

said, "*Penda* fits the model of this school. Teachers have to collaborate with each other every day. They're so busy that they can't take on new things unless they are easy and practical. Eight out of ten of my teachers picked up *Penda* without any special training."

Another teacher time-saver is *Penda*'s near auto-instructional capability. Just as in our personal lives no one has to spend a week-end learning how to use an automatic teller machine, *Penda* is at least as transparent. Teachers launched it (with very little time required) and the students picked it up and began to manage their own learning, move at their own pace. One signal of how truly user-friendly the system is can be found in the size of the groups where it is being used. One Florida high school brought 1,000 students into contact with *Penda* in single-session visits to the school's computer labs. Within 20 minutes, the students were independent users and, in that school, the administrators estimated that for every minute of school use, the students voluntarily added a minute of at-home use. A New York City high school with a 4,000+ student enrollment had a similar experience (see 5.2 below).

There are two ways to summarize the conclusions of these educators – first, teacher opinions and second purchasing plans. One assistant principal said it was the only piece of software in his career about which there were *no teacher complaints.* And the administrators and supervisors said:

- "Next year, we're going to put this on the front burner from Day One."
- "I'm definitely going to use it next year."
- "I'm going to try to get the money to use *Penda* next year."

6.2 New York educators

The *New York Times* has recently reported:

> In an era when school districts nationwide are under immense pressure to increase test scores and graduation rates, cities like New York, Chicago and Washington have turned to alternatives known as credit recovery to prevent struggling students from dropping out. (Hernandez, *New York Times*, July 13, 2009)

Penda was added to a credit-recovery program for a New York City high school. Those programs give students a second strike but in New York there are two requirements for earned credit. The student has to perform but also to log a minimum number of hours of 'seat time'. In New York's very large schools, there are hundreds of students who need to make up credits or they won't graduate. *Penda*'s record keeping made it easy for hard-pressed teachers and administrators to certify the necessary elapsed-time requirements. "It's easy to create the paper trail." And, as one teacher put it, "I don't have to make up 200 of my own quiz items. I can point-and-click on the items that are already linked to each exercise."

In that school, students who had not previously had much success quickly became attached to the records of their performance on *Penda*'s individual units. The teachers would set high thresholds for passing and the students would seek them out in the next period to show their teachers their personalized "*Penda* transcript" that documented

how well they had done. One evening-school student had tried without success to catch up with her deficient course credits. In a matter of weeks she successfully accomplished her first recovered credits.

A veteran New York high school teacher turned supervisor said, “The kids don’t want teachers whining at them and carrying on. The kids are embarrassed by their mistakes but with *Penda*, all that’s private and they just try again. My guidance counselors talk up the importance of recovering credits in order to graduate but it’s in one ear and out the other. With *Penda*, the kids do what the guidance counselors have never been able to do---they recruit their friends to use the system.”

6.3 Recommendations from school leaders

School people are already using *Penda* for credit recovery and for enhancement. The school people recognized that *Penda* is organized by levels of difficulty and recommended that more materials at the higher end would make the products more useful to more students. One way to think about that is in the transition from the original Bloom’s Taxonomy to Anderson’s revised taxonomy to Churches’ Digital Taxonomy. The challenge for *Penda* is to grow students’ higher order thinking skills by adding even more e-features to the Company’s applications.

Table 12: Developments in Conceptualizing Challenges for Students			
	Bloom's Taxonomy	**Anderson's Revision**	**Churches' Digital Taxonomy**
Higher	Evaluation	Creating	Constructing, mixing, wiki-ing, publishing, podcasting, directing/producing
	Synthesis	Evaluating	Reviewing, posting, moderating, collaborating, networking
	Analysis	Analyzing	Mashing, tagging, linking, comparing
	Application	Applying	Running, loading, hacking, sharing, editing
	Comprehension	Understanding	Advanced searching, blogging, twittering
Lower	Knowledge	Remembering	Googling, bookmarking, recognizing, listing,

Appendix A: Methods

This external analysis was performed with data supplied by *Penda* and the Orange County Public Schools in Florida. Using SPSS, we searched for associations between aspects of *Penda* use and various performance metrics including achievement on the Florida Comprehensive Assessment Test. We had files from more than 8,000 *Penda* users in the U.S. We also interviewed educators who had used *Penda* in Florida and New York.

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Appendix C: About Interactive, Inc.

Interactive, Inc. is listed on the US Department of Education's Institute of Education Science 'gold standard' *Registry of Outcome Evaluators* and was one of the Department's contractors for a longitudinal, West Virginia statewide documentation of the effects of technology on student achievement and school improvement. The firm's 200+ past and present R&E sites and clients include:

School Districts & States	*Corporations*
Atlanta	Dell Computers
Boston	Scholastic
Cleveland	e-Sylvan
Columbus	Homeroom.com
Dallas	Houghton-Mifflin
Houston	LeapFrog
Miami-Dade	Lightspan
New York City	Plato Learning, Inc.
San Francisco	Pearson
States of Alabama, Arizona,	Compass Learning
New York, Pennsylvania,	K12, Inc.
Virginia and West Virginia	Sun Microsystems

The firm's founder and managing director is Dale Mann, Ph.D., Professor Emeritus at Columbia University (Teachers College and the School for International & Public Affairs). Since 1985, he has concentrated in developing and evaluating the gains from e-learning, a field in which Mr. Mann has been identified as one of America's ten most influential leaders.