



The Impact of DyKnow Software across Educational Institutions

A Report on Documented Gains in Student Achievement and Engagement

This paper summarizes published data demonstrating the effectiveness of DyKnow software deployments in a wide range of K12 and higher education environments. The paper begins with an introduction that sets the context for the data that follows. The paper then provides several types of supporting documentation each of which can be read on its own:

- Published data demonstrating the impact of DyKnow software on student learning, test scores, and grades;
- The involvement of external organizations such as The National Science Foundation, EDUCAUSE, the Lilly Endowment, Microsoft Research and Hewlett-Packard; and
- Published survey results that formally measure the attitudes of students and teachers who have used DyKnow tools on a regular basis.

The authors acknowledge that no single evaluation metric presented in the paper is conclusive; however, taken in total, the evidence clearly demonstrates that the DyKnow approach is effective.

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1. Introduction and Background

DyKnow software tools have been successfully deployed in settings including grade schools, public and private high schools, junior colleges, private four-year colleges, public comprehensive universities, and graduate programs. Many of these deployments have included evaluation components that demonstrate positive changes that result from the use of DyKnow tools. Most of these outcomes have already been published in academic papers, grant-proposals, popular press articles and case-studies. However, we believe there is value in providing a summative whitepaper that captures the most important of these results. We do not claim that any single evaluation metric is conclusive; however, we believe that taken in total the evidence clearly demonstrates that the DyKnow approach is effective.

This paper assumes that the reader is already familiar with the basic functionality of the patented DyKnow software tools. Readers who are not familiar with this functionality are encouraged to visit www.dyknow.com to gain appropriate background.

While we have received numerous anecdotal comments from faculty members and students that convey their excitement toward using DyKnow software, this paper limits itself to reporting on more measurable outcomes. On the other hand,

it is important to recognize that the grade reports and grant awards described in this whitepaper result from aggregating numerous individualized experiences of students and teachers. These individual experiences are what make or break a successful classroom deployment. Thus, to set the context for the more formal evaluation that follows, we set the stage with quotations that convey three individual's enthusiasm toward the use of DyKnow tools:

"It is an invaluable learning tool that makes the classroom experience much more engaging, efficient, and effective."

- K12 Student, Park Tudor School

"You practice things you need to practice. Math and CS are things you must practice if you want to do well in and this really helps. I enrolled in this class a few semesters ago (two years, I think) and struggled in it before dropping the class. I really think that [DyKnow Vision] has been the difference because now I have a high B and am cruising along and it has come kind of easy for me."

- University Student, DePauw University

"DyKnow Vision allows my students to focus more on understanding and practicing the required concepts, and as a result, they have become more confident and successful when solving problems and answering the questions."

- Luise Strange, PhD Professor, Georgia Perimeter College

The remainder of this paper is organized into sections based on categories of evaluation information. Section 2 summarizes published data related to improvements in student learning as demonstrated through test scores and grades. Section 3 describes grant support and other awards that have been associated with DyKnow deployments. We believe this support (often from prestigious government, private and commercial organizations such as The National Science Foundation, EDUCAUSE, Microsoft Research and Hewlett-Packard) validates the DyKnow approach. Finally, Section 4 summarizes results from several surveys that measure student and teacher attitudes toward the use of DyKnow software tools. Whenever possible, we directly quote original papers, articles, and grant proposals rather than paraphrasing their authors. While this may result in less fluid writing, we hope it more accurately conveys the original meaning of the authors.

2. Published Data Related to Student Learning, Test Scores and Grades

A number of instructors and external evaluators have documented an improvement in student learning as a result of deploying DyKnow tools. Specific examples of improvements measured on assignments, tests, and overall class performance are provided in the remainder of this section.

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2.1 Data from K12 Deployments

We begin by considering comments from David Schroeder, a Mathematics teacher at Cabrillo High School in Lompoc, California. In an article published in T.H.E. Journal, Schroeder reflects on his initial experiences deploying DyKnow Vision by writing “I used DyKnow [Vision] on the tablet PCs in my Math II class, a two-semester mathematics course, [for the first time] during the 2003-2004 academic year. Mainly geared toward sophomores, the course becomes progressively harder by the second semester as more abstract topics are introduced. Using DyKnow [Vision] in Math II, second-semester final exam averages improved from 72% to 82% between the 2002-2003 and 2003-2004 academic years” (Shroeder, 2004). These are noteworthy results, particularly given the abstract nature of the course content.

Additional data comes from North Daviess Elementary School located in a rural Elnora, Indiana. The North Daviess DyKnow deployment was evaluated in the spring of 2005 by researchers from ROCKMAN ET AL, an independent research and consulting firm that specializes in exploring the impact of technology on learning. ROCKMAN researchers wrote a case study “based on a day-long visit [to North Daviess Elementary School] that included a series of interviews (with teachers, students, and school administrators), classroom observations, and collection of background data and samples of instructional materials created using DyKnow Vision” (Rockman, 2005). In summarizing an interview with the school principal Jodi Berry, the case study states: “Jodi indicated that standardized testing scores have gone up, especially among Special Education students who are making use of the technology on a regular basis (this finding is based on scores from NWEA tests—a standardized test developed by the Northwest Evaluation Association—administered three times each year). While it is somewhat difficult to separate the unique effects of DyKnow Vision from those associated with the [technology initiatives] in general, Jodi also indicated that attendance in the classes with portable computers has gone up and discipline problems have gone down. She also finds that homework submissions are higher (i.e., fewer missing or incomplete assignments), and there is a sense that students are more motivated to learn because the method of instructional delivery (i.e., via laptop and tablet technology, using products like DyKnow Vision) is more interesting and appealing to students” (Rockman, 2005).

2.2 Data from Higher Education Deployments

Publications describing evaluations of DyKnow deployments at four-year institutions also demonstrate improved student learning. For example, in a chapter of a Purdue University Press book entitled *The Impact of Tablet PCs and Pen-based Technology on Education*, Terry James, Jan Hill, Charlotte Cone, and Sherri Latimer thoroughly evaluate a DyKnow deployment at the University of Central Arkansas. The chapter describes a study of a multi-section general psychology course and a second study of a multi-section kinesiology/health

education course. Within each study the same instructor taught at least one control section of the course and at least one pilot section that used DyKnow software tools (James, 2006). The authors write: "In general psychology, 87 percent of the students in the pilot [DyKnow] section earned a C grade or better compared with 73 percent in the control sections; 13.3 percent of the students in the pilot [DyKnow] section withdrew compared with 23.7 percent in the control sections" (James, 2006). The authors report similar results in the kinesiology/health education courses: "91 percent of students in the pilot [DyKnow] section earned a C grade or better compared to 84.8 percent in the control sections; no students in the pilot sections withdrew compared to 4.85 percent of students in the control sections" (James, 2006). The repeatability of the study in multiple disciplines is especially compelling.

Another chapter of the Purdue University Press book reports on a deployment of DyKnow software that involves dozens of courses per semester at DePauw University. The evaluation section of this chapter includes a comparison of student performance in two sections of an introductory computer science course. In explaining the comparison the chapter states "DePauw's computer science department offers several sections of its introductory computer science course each semester. Regardless of the instructor, the sections use a common book as well as common projects and exams. These exams are written jointly by all faculty members who are teaching the course, and are given at a common time in the evening. Because this course is seen as a departmental venture, it is a relatively stable course and this makes it easy to compare student performance across semesters" (Berque, 2006).

The chapter goes on to compare student performance the last time the author taught the introductory computer science course in a traditional classroom (22 students) to the first offering of this course using the DyKnow software on a daily basis (23 students). The chapter notes "[grades] appear to have improved between the 'before' and 'after' courses described above. Specifically, the 'before' course has a mean semester grade of 2.98 on a 4.0 scale including one grade of F and two grades of D+. On the other hand, the 'after' class had a mean semester grade of 3.27 with no grades of F and one grade of D" (Berque, 2006).

Instructors at the Junior College level have also noticed improvements in student achievement when using DyKnow tools. The March 15, 2006 issue of Campus Technology features an article by Linda Briggs that notes "[engaging students to promote learning] can be difficult to achieve, especially when students represent a wide range of learning abilities and backgrounds. At Joliet Junior College in Illinois, Professor Rich McNeil is using technology to help students get involved and stay engaged using an interactive learning product called DyKnow Vision"

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(Briggs, 2006). The article further explains “McNeil’s teaching challenge at Joliet Junior College is exacerbated by the wide range of student ages and learning experiences. He says that students in his evening class range in age from 18 to 65. But regardless of the fact that older students may not be used to computers in classrooms, McNeil says quiz scores are up, grades are higher, student confusion has decreased, and questions are more on track.” McNeil explains “I’ve had whole classes complete an entire lab assignment perfectly, without any questions. It’s because of the way they can go back and review, study, and focus their attention” (Briggs, 2006). This study is particularly notable due to the diverse student group that is involved.

3. Grant Support and Other Awards

While the majority of schools have used internal funding to deploy DyKnow software, several deployments have been supported with grants from government, private and/or commercial funding sources. In some cases these grants have been awarded to support a new DyKnow deployment. In other cases the awards have been made to help a school expand a DyKnow deployment that has already proven to be successful on a smaller scale. In addition, several schools have received grant funding to

support a broader technology vision (such as improving student engagement) and have later chosen DyKnow software as a specific way to achieve the central objective. Finally, several schools that use DyKnow tools have received recognition for their innovative uses of instructional technology. Details are provided in the remainder of this section.

3.1 Grants and other Awards for K12 Schools

According to an article in T.H.E. Journal, Cabrillo High School deployed DyKnow software as part of an initiative to “form a school within a school called the Marine Technology Institute. The theory behind the new program was to teach math, science and English in a way that would use technology to focus on the ocean, while allowing [Cabrillo] to incorporate the aquarium and its resources into our lesson plans. It was all part of a plan to inject excitement and interest into the classroom; ultimately, to re-engage our students. To take the program a step further, [Cabrillo] leveraged a portion of a four-year California education grant to purchase...DyKnow [Vision]” (Schroeder, 2004).

North Daviess Elementary School has also used grant support to deploy DyKnow tools. According to a case study written about the North Daviess School, “... teachers helped write the EdTech grant that enabled the school to purchase the technology and software, so they were comfortable with the idea of integrating technology into their instruction” (Rockman, 2005).

The Cloverdale Community School Corporation has used an Indiana State Workforce Development grant to fund its initial deployment of DyKnow software. According to the State’s news release, “the initiative will improve academic

achievement and better prepare [Indiana] students for post-secondary options. Funding will allow the institutions to prepare a curriculum on the leading edge of academic and technical standards. Overall, the program will create an easier, more effective transition between high school and post-secondary options for students. The grants to the schools focus on building science, technology, engineering, mathematics and entrepreneurship skills" (Indiana, 2006).

Finally, one of the first K12 schools to pioneer Tablet PC computing in conjunction with DyKnow tools has recently been recognized for its instructional technology leadership. According to a school press release, Bishop Hartley High School in Columbus, OH, was recognized by The Peter Li Education Group "as one of three 2006 winners of Catholic Schools for Tomorrow Award for Innovations in Education. Bishop Hartley High School received recognition in the category of Innovative Projects Facilitated by Technology. Only twelve elementary and secondary schools in the country received recognition in any category" (Collura, 2006).

3.2 Grants and Other Awards for Higher Education Institutions

For the past few years Hewlett-Packard has funded a "Teaching with Technology" grant program. Through this program higher education institutions compete for award packages that include 21 Tablet PCs, additional equipment and funds to support project-related expenses for "two- and four-year colleges and universities engaged in transforming teaching and learning through the integration of technology in the classroom and beyond" (Hewlett-Packard, 2006). In recent years several schools have received these grants for projects that have included the use of DyKnow software tools. For example, the Eller College of Management at the University of Arizona is piloting DyKnow software in business courses in tandem with a Hewlett-Packard grant. DePauw University is using DyKnow software to support group work in several computer science courses in conjunction with equipment provided by a Hewlett-Packard grant. A third institution, Rose-Hulman Institute of Technology, located in Terre Haute, Indiana, is also using DyKnow software in a project that is supported by a Hewlett-Packard Teaching with Technology grant (Hewlett-Packard, 2006).

Rose-Hulman's work is especially noteworthy because it is also being supported by a grant initiative from Microsoft Research. The Microsoft grant program that funded this work was extremely competitive with only eleven proposals receiving funding nationwide. According to Microsoft Research's web site, the objective of the grant program is to serve as "a catalyst to encourage educators to apply resources toward revising, updating, and validating curriculum and pedagogy in conjunction with tablet technology in higher education" (Microsoft, 2006). An excerpt from the abstract for Rose-Hulman's funded proposal reads: "Our project leverages our previous award of Tablet PCs from Hewlett Packard with our expertise and experience with DyKnow Vision software that facilitates collaboration in the classroom. At Rose-Hulman we have developed curricula that use Tablet PCs and DyKnow in five courses drawn from three disciplines.

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What we have observed is that Tablet PCs and their pen-based capability cannot be exploited completely without software like DyKnow that encourages many types of collaboration—between faculty and students, between students, and between one class and another. Thus, our project will assess and evaluate the impact of a symbiosis of hardware (Tablet PCs) and software (DyKnow) on teaching and learning” (Microsoft, 2006).

A private institution in western Pennsylvania, Grove City College, also received a grant from Microsoft Research to support a project that involves DyKnow tools. Grove City College has a mandatory Tablet PC program that provides Tablet PCs to all incoming students. With support from Microsoft Research, Grove City College researchers will study learning outcomes that result from combining these hardware devices with a variety of software solutions including DyKnow tools (Microsoft, 2006).

As reported in a chapter of a Purdue University Press book *The Impact of Tablet PCs and Pen-based Technology on Education*, the University of Central Arkansas is using government grant funding to support its DyKnow deployment. The chapter states “A Title III ‘Strengthening Institutions’ grant... focusing on infusing technology into general education courses was awarded to the University of Central Arkansas (UCA) in October 2001. A major initiative for year four was to incorporate DyKnow Vision software into three general education courses” (James, 2006).

Several additional schools are using government and foundation grant support to fund DyKnow deployments. For example, as reported in a March, 2006 issue of *Richmond Now*, The University of Richmond received a prestigious United States National Science Foundation (NSF) grant to reform mathematics and computer science courses using DyKnow tools (Richmond Now, 2006). With respect to private funding, Taylor University is entering its third year of DyKnow usage with funding from a Lilly Endowment grant (Taylor, 2005).

Finally, we note that DePauw University has received significant national recognition for its instructional technology innovations, including its use of DyKnow tools. In an EDUCAUSE Quarterly article entitled “The 361° Model for Transforming Teaching and Learning with Technology,” Dennis Trinkle (then Associate Vice President for Academic Affairs and Chief Information Officer at DePauw University) notes that in recognition of its successes, DePauw received the 2004 EDUCAUSE Award for Systemic Progress in Teaching and Learning, and that the university was recently named the Third Most Connected University in the country by *Forbes.com* (Trinkle, 2006). Trinkle’s article states that a key benefit of DePauw’s uses of technology has been to remove communication barriers between teachers and students. He cites DyKnow as “one of the best examples of this.” He writes, “With DyKnow, the technology removes barriers to learning and helps connect instructor and students in active, engaged learning. This is the goal for all technology at DePauw” (Trinkle, 2006).

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In summary, a number of government, private and commercial organizations have recognized and/or funded effective use of DyKnow software tools. The involvement of these external granting and award agencies, usually after a rigorous review process, further validates the instructional validity of the DyKnow approach.

4. Student Attitudes

A number of papers and articles have reported on surveys that measure student and/or teacher attitudes toward DyKnow tools. This section provides excerpts from these surveys from both K12 and higher education environments.

4.1 Student Attitude Surveys in K12 Environments

As an initial example of student survey results we look to an October 2005 story in eSchool News Online. The story reports on students in Diane Hamstra's high school English class at Park Tudor School in Indianapolis. The story explains "after using [DyKnow] to annotate a difficult literary text to draw conclusions about it, Hamstra asked her students to complete a survey about their use of DyKnow...

Student responses were as follows:

- 94 percent of students rated their understanding of the class material as improved when using DyKnow rather than using pen and paper;
- 87 percent of students found it valuable to see others' work using DyKnow; and
- 87 percent of students rated the effectiveness of annotating the text electronically higher than that of using pen and paper."

The story goes on to report that "Hamstra was pleased to find that the results of the survey reflected her own belief in the software. She is eager to continue exploring different ways to use DyKnow in her English classes this year" (eSchool News Online, 2005). Hamstra was further quoted in Edutopia, stating, "The difference is startling. Using the software, the students' responses were deeper than with pen and ink. The focus was really sharp" (Edutopia, 2005).

4.2 Student and Teacher Attitude Surveys in Higher Education Environments

Results of surveys about student opinions toward the use of DyKnow tools in several courses at Rose-Hulman Institute of Technology were presented in a paper in the proceedings of the 36th ASEE/IEEE Frontiers in Education Conference (Chambers, 2006). The paper reports on several survey instruments that illustrate positive student attitudes toward DyKnow software. In particular the paper notes that "...students [in a software development course] responded to the statement: 'The use of DyKnow contributes to my learning in this class' by choosing one of: Strongly Disagree, Disagree, Agree, or Strongly Agree. The results were striking: every one of the 24 students responded either Agree or Strongly Agree, with a

mean of 3.44 on a 4-point scale. Comments indicated that they especially liked: more interactive discussions; permanence of notes; and dual use of laptop projector and DyKnow screens” (Chambers, 2006). One student commented ‘It is both fluid (able to be interacted with) and permanent (can be saved to access later)”(Chambers, 2006).

A more extensive survey of opinions toward DyKnow software was conducted at DePauw University and originally reported in a chapter of *The Impact of Tablet PCs and Pen-based Technology on Education* (Berque, 2006). All DePauw University computer science majors and minors were invited to participate in the survey; the 81 student respondents had taken a total of 399 computer science courses using DyKnow tools. The participants had also collectively enrolled in 21 economics courses, six English courses, four Japanese courses, and one communications course using the system. Thus, the total number of enrollments in DyKnow courses was 431.

As a measure of general satisfaction, the survey asked students to indicate their level of agreement with the statement: Overall DyKnow has had a positive impact on what I have learned as a Computer Science major or minor. Seventy nine of the 81 students agreed with the statement (with 59 of these students strongly agreeing and 20 agreeing somewhat). One student was neutral, one student disagreed somewhat, and no students strongly disagreed.

A parallel survey was also administered to faculty members who had taught with the system at DePauw. Because a reasonably large number of computer science students had also taken economics courses using DyKnow, both computer science and economics instructors were surveyed. Ten faculty surveys were received. Collectively these instructors had taught 90 courses using the DyKnow software.

Results from the instructors who were surveyed were similarly positive. In fact, 100% of the teachers agreed or strongly agreed with the statement: DyKnow has had a positive impact on student learning in my classes.

The survey also provides some limited evidence that DePauw’s use of pen-based technology and DyKnow software is having a positive impact on University recruiting efforts. In particular, 32% of students reported that they had first learned about DyKnow while they were prospective students. Of this group 77% report that DyKnow had positive influence on their decision to attend DePauw. One student wrote: “I think the DyKnow system has been valuable, and it definitely got me excited about coming to DePauw. I remember being brought through [the science building] ... and having DyKnow described to me. It was a big selling point.”

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Summary

This paper presents data that illustrate the effectiveness of DyKnow software tools. The data has been drawn from a variety of K12 and higher education DyKnow deployments. The interested reader is invited to consult the references below for more detailed information about the papers and articles cited herein. The interested reader is also encouraged to visit www.dyknow.com for more information about DyKnow software features and functionality.

References

(Berque, 2006) Pushing Forty (Courses per Semester): Pen-Computing and DyKnow Tools at DePauw University, in *The Impact of Tablet PCs and Pen-based Technology on Education*, Purdue University Press, 2006, pp 31 – 39.

(Briggs, 2006) Interactivity in Class Engages Students, *Campus Technology*, March, 2006, http://campustechnology.com/news_article.asp?id=18105&typeid=156

(Chambers, 2006) (with Chidanandan A., DeVasher R., Minster M., Mitra-Kirtley S., Mutchler D., Sexton S., Watt A. and Williams J.) What is Beyond the Laptop Initiative? Perhaps: Tablet PCs and DyKnow Vision Software, in proceedings of the 36th ASEE/IEEE Frontiers in Education Conference, October, 2006, San Diego, CA.

(Collura, 2006) Bishop Hartley High School Press Release, March, 2006, http://www.bishop-hartley.org/files/press_release%202%2003-08-06.pdf

(eSchool News Online, 2005) DyKnow Instructional Software Transforms Lectures into Collaborative Labs, eSchool News Online, www.eschoolnews.com/news/showStory.cfm?ArticleID=5887

(Edutopia, 2005) Synching Up With The iKid, *Edutopia Magazine*, October, 2005, http://www.edutopia.org/magazine/ed1article.php?id=Art_1355&issue=oct_05

(Hewlett-Packard, 2006) Teaching with Technology Grant Initiative, program home page at http://www.hp.com/hpinfo/grants/us/programs/tech_teaching/index.html

(Indiana, 2006) Indiana Department of Workforce Development, Indiana Workforce Development News Release, June, 2006, www.in.gov/dwd/newsroom/news_releases/NR_06-12-06.pdf

(James, 2006) (with Hill J., Cone C., and Latimer S.) The Calf- Path: One University's Experiences with Pen-enabled Technologies, in *The Impact of Tablet PCs and Pen-based Technology on Education*, Purdue University Press, 2006, pp 95 – 102.

(Microsoft, 2006) Tablet PC Technology, Curriculum, and Higher Education 2005 RFP Awards, Program Home Page http://research.microsoft.com/ur/us/fundingopps/RFPs/TabletTech2005_RFP_Awards.aspx

(Richmond Now, 2006) Math with a Twist: Tablet laptops allow students to take notes on the screen, Richmond Now, The Faculty, Staff, and Student Newspaper of the University of Richmond, http://oncampus.richmond.edu/news/richmondnow/March2006/math_twist.htm

(Rockman, 2005) A Case Study of DyKnow Vision: Conversations and Observations that Demonstrate its Educational Potential, Rockman et al, June, 2005, <http://www.dyknow.com/products/more/North%20Davies%20case%20study%20-%20FINAL.pdf>

(Schroeder, 2004) Tablet PCs and Collaboration Software Improve Classroom Engagement at Cabrillo High School, in T.H.E. Journal, November, 2004, <http://www.thejournal.com/articles/17040>

(Taylor, 2005) Taylor University Changes the Classroom with Decision to use DyKnow Vision Software, DyKnow news release, April, 2005, <http://www.dyknow.com/news/releases/taylor.htm>

(Trinkle, 2006) The 361° Model for Transforming Teaching and Learning with Technology, in Educause Quarterly Volume 28, Number 4, 2005, <http://www.educause.edu/apps/eq/eqm05/eqm0543.asp?bhcp=1>

About DyKnow

A leader in interactive education, DyKnow combines sound teaching with intuitive technology to create the most flexible and effective solutions for teaching and learning. DyKnow is committed to helping teachers maximize class time and foster collaboration while also minimizing electronic distraction. By promoting effective studying and gathering student feedback teachers can feel confident in students' academic success.