



**NovaNET® Courseware for Grades 6-12:
Developed, Validated, and Refined by Research**

Introduction

With its long and successful history, the NovaNET® online courseware system is proven to help middle and high school students achieve success. In light of new legislation and the demand for research-based solutions to boost student achievement across the K-12 enterprise, NovaNET stands out as an option that fulfills all of these requirements. Developed, validated, and refined by research, NovaNET has been demonstrated to improve test results, reduce drop-out and at-risk rates, and increase student self-confidence.

Developed by research

History

NovaNET is a computer-based, online courseware system that links educators with progressive technology and proven teaching methods. The NovaNET learning system is the culmination of more than 35 years of educational research and technological development that started at the University of Illinois at Urbana Champaign (UIUC) Computer-based Education Research Laboratory (CERL). CERL was awarded a National Science Foundation (NSF) grant in the late 1960's to develop a computer based learning system. The curricular materials completed under the grant are the foundation of what has grown into the NovaNET system—a computer-based learning system that offers an extensive online library of interactive instructional courseware, providing learners and teachers with access to thousands of hours of self paced, mastery-based instruction.

Instructional Strategies

Many of the design strategies in NovaNET employ adaptive instruction techniques. Adaptive instruction is a method that considers individual differences in ability, knowledge, interests, goals, contexts, self-efficacy, and learning styles. Adaptive instruction gives teachers the power to effectively tailor their teaching practices, accommodating to the individual needs of the learner.

Instructional adaptation can be described on two levels: macro-adaptation and micro-adaptation. Macro-adaptation is the global, long-term variations that occur within a curriculum such as the selection of appropriate content. Within NovaNET, this occurs in the form of recommending appropriate lessons based upon a prescriptive test. Micro-adaptation describes the immediate, moment to moment accommodation that occurs throughout a lesson such as the provision of individual feedback, reinforcement, and pacing. Common within NovaNET lessons are the following four adaptive instructional techniques: 1) pacing; 2) prescription; 3) dynamic questioning; and 4) intelligent feedback.

Pacing

Perhaps, the most advantageous micro-adaptation is that of individualized pacing. Pacing instruction to the needs of the learner (often in the form of self-pacing) generally leads to gains in efficiency and interest without sacrificing effectiveness. The concept of mastery is central to the implementation of individualized pacing. Mastery is the approach of verifying that an individual student has learned relevant content before instruction is continued. Most NovaNET lessons follow this strategy.

Additionally, individually paced material allows instruction to be assigned or selected at the appropriate time for the individual. Instruction can be provided when the student is sufficiently prepared and interested—an opportunity that many teachers refer to as the “teaching moment.”

Prescriptions

At the heart of the standardized curricula is the notion of prescriptive lesson assignment. Pre-testing allows the system to automatically identify individualized weaknesses and assign appropriate content. This form of macro-adaptation provides students with instructional materials appropriate to their individual learning stage. Through prescriptive assignment, we assure that all materials are “developmentally appropriate” for each student. In addition to pre-testing, another prominent feature of the NovaNET standardized curricula is embedded post-tests. While post-tests are usually not involved in prescribing future content (although many times they do recommend select review materials), they serve a mastery role that paces the instruction to the learning speed appropriate to the individual.

Dynamic Questioning

NovaNET lessons provide further adaptation through the use of dynamic questioning, a process that generates questions as a lesson progresses rather than preparing all questions in advance. Generating questions dynamically is performed by all effective teachers during activities such as group discussion and one-on-one tutoring. Questions are tailored to reveal the present misconceptions of the students and to guide them toward mastery. Many lessons in NovaNET generate questions dynamically, never asking the same question twice. Each time, the question is posed in a significantly different way.

To some, dynamic questioning such as the randomizing of the order of distracters in a multiple-choice question has the appearance of minor importance. However, considerable research has shown that distracter randomization prevents students from merely learning the “position” of the correct response. As a consequence, the use of distracter randomization leads to deeper and more effective concept of development.

Examples of distracter randomization can be found in the math lesson series beginning with “Factoring Polynomials.”

Randomizing distracters is a common but far from the only technique used in dynamic questioning. Advanced forms of dynamic questioning can be seen in the “corrective feedback paradigm.” Here, the order of questions is determined by the individual prior to performance. If a question is missed, the concept is repeatedly tested at increasing intervals until mastery is determined. In some cases, misconceptions between two discrete concepts are reviewed in detail before continuing with the larger lesson. These are excellent examples of micro-adaptation. Each educational experience is different and tailored specifically to meet individual needs. Many of the dynamic questioning techniques used by NovaNET lessons are capable of generating virtually unlimited numbers of appropriate questions at the time of need. A large part of effective instruction is asking the right question at the right time.

Examples of dynamic questioning can be found in NovaNET World History lessons such as “Age of Revolution” and the Geometry lesson “Polygon.”

Intelligent Feedback

Feedback plays a critical role in adapting to individual student differences. Many computer-based lessons rely on informing the learner of the correct or incorrect status of a response. Much of the NovaNET instruction, however, goes beyond this most basic level of feedback, providing the learner with additional direction such as describing why a particular answer is wrong and how it can be corrected. This is what is meant by “intelligent” feedback.

Examples of intelligent feedback can be found throughout NovaNET.

- Misspellings, capitalization errors, inaccurate word order and other errors are commonly indicated with visual cues, such as color-coded arrows. The Algebra lesson “Solving Word Problems” is one of many examples.
- For clear, text based intelligent feedback, the Language Arts lesson “Main Ideas” redirects the student on incorrect responses. A similar feature is utilized in the lesson “Fractional Distillation Experiment.”
- Within the Geometry series, the lesson “Area: Rectangles” gives the student several tries to answer the questions correctly. Each time they fail, the feedback becomes more specific, guiding the students to a correct response.
- In the lesson “The Human Skeleton”, students are asked to recall the names of bones indicated on a skeleton. When students make certain kinds of errors (recalling the name of one bone for another), the lesson recognizes the type of error and responds with feedback and further questions to aid the student in differentiating the two facts.

The four techniques described above bring about instructional experiences adapted to individual needs. While rich in content, classroom based lectures and presentations are generally ineffective in providing the level of adaptation available through one-on-one instruction. On the other hand, well-designed computer-based education is very capable of and designed specifically to provide such effective, individualized instruction.

Validated by research

A general overview of the evidence

Evidence has consistently shown that computer-assisted, mastery-based instruction has a positive effect on student achievement. Kulik, Bangert, and Williams¹ used results from fifty-one independent evaluations of computer assisted instruction (CAI) in grades 6-12. Their findings indicated: 1) higher performance on final examinations, 2) positive effects on follow up examinations, 3) substantial savings in learning time, and 4) positive attitudes by students toward both the computer and their courses.

The most rigorous studies of CAI effectiveness have been conducted by James Kulik and his colleagues at the University of Michigan (Kulik, Kulik, and Bangert-Drowns, 1985² and Bangert-Drowns, Kulik, and Kulik, 1985³). These reviews all report reliable modes positive effects of CAI at all levels of formal education. These researchers used a statistical approach called meta-analysis, which in recent years has become increasingly popular to integrate findings from a large number of studies.

The following snapshots of schools document the effective use of the NovaNET system for their students:

Continuing Education Academy (CEA), Tolleson, Arizona

CEA enrolls 281 students in grades 9 to 12 from two different high schools. Ninety-four are part-time students and 187 are full-time students. The school enrolls those who face significant life challenges and special circumstances prohibiting attendance in a traditional school, such as parenting or holding down a full time job. According to Dr. Ann Stover, instructor at CEA, "Our main difficulty is keeping students in school and on track to graduate." The graduation rate in 1995 was 53 percent in Tolleson Union School District; they needed to implement a program to help students stay on track to graduate. Since implementing NovaNET in 1995, the graduation rate from Tolleson Union High School District (TUSHD) has risen 15 percent. 2001 graduation was at 68.3 percent, up from 53 percent in 1995. Based on the current trend, projections indicate that this rate will increase to 70.7 percent in 2002. During the 2000-01 school year, at-risk students in grades 9 through 12 recovered 338.5 credits and 126 at-risk seniors completed coursework fulfilling graduation requirements, all primarily due to the successful implementation of the NovaNET system.

Austin Independent School District (AISD) Austin, Texas

The Austin Independent School District offers Diversified Education through Leadership, Technology, and Academics (DELTA) school-within-a-school program in each of its ten high schools, its Alternative Learning Center, and several of its middle schools for students who have dropped out or are at risk of dropping out. DELTA is an open-entry, open-exit program that uses the NovaNET system to provide self-paced, mastery-based learning. More than half of DELTA students are considered at-risk and 31 percent are former dropouts.

Since installing the NovaNET system at its DELTA program sites, AISD's dropout rate has fallen to an all time low of 2 percent.

Spokane Public School District, Spokane, Washington

In an effort designed to reduce dropout rates and to increase test scores, the Spokane Public School District installed the NovaNET learning system in its school-within-a-school program, the Learning Opportunity Center (LOC) in seven high schools in 1996 and in one middle school in 1997. The LOC program in high schools uses NovaNET to provide students a chance to earn needed credit or to work a class into a tight schedule. The middle school uses NovaNET for skill building, increasing confidence in learning, and increasing retention and retrieval. An examination of the effectiveness of NovaNET in the LOC program at Ferris High School showed gains of 2 to 6 grade levels in five key subjects during the 1996-97 school year: problem solving (2 grade levels gained); language (5.5 grade levels gained); reading (3 grade levels gained); mathematics (6 grade levels gained); and vocabulary (5 grade levels gained). In addition, of the 182 students in the Ferris LOC, 95 percent completed the program.

Gallup Central High School, Gallup, New Mexico

Gallup Central High School is located in the northwest part of New Mexico, serves grades 9 through 12, and enrolls 386 students. The school's goal was to find a program that would help students with credit recovery. The alternative high school needed flexibility while providing students with individual education plans. Since implementation in 1998, students have been using NovaNET to recover and gain credit toward their high school diplomas. In addition, with the help of NovaNET, at-risk students are given the opportunity to excel and graduate despite personal setbacks. As enrollment has steadily increased, the percentage of students dropping out has remained low.

Year	Total Enrollment	Dropouts	Dropout Rate
2001	322	31	9.6%
2000	360	29	8.1%
1999	303	48	15.8%
1998	261	6	2.3%
1997	165	45	27.3%
1996	152	38	25%
1995	123	77	62.6%



NovaNET implemented here.

Refined by research

Research on the NovaNET system, like the system itself, is evolutionary. The initial research begun in the 1960's involved systematic investigation, including development, testing and evaluation of system and software design. This research continued into the 2000s.

Currently, with increased recognition and acceptance of qualitative methodology in education research, the NovaNET system is utilizing site-based case study to demonstrate effectiveness and guide implementation. Throughout this evolution the NovaNET system has relied on its large community of users in direct connection with developers to identify problems, correct deficiencies, and expand capabilities.

Further Reading

¹J.A. Kulik, R.L. Bangert, and G.W. Williams, “Effects of Computer-Based Teaching on Secondary School Students, *Journal of Educational Psychology*” 75 (February, 1983) 19-26.

²James A. Kulik, Chen-Lin C. Kulik, and Robert L. Bangert-Drowns, “Effectiveness of Computer Based Education in Elementary Schools, *Computers in Human Behavior*” 1 (1985), 59-74.

³Robert L. Bangert-Drowns, James A. Kulik, and Chen-Lin C. Kulik, “Effectiveness of Computer Based Education in Secondary School, *Journal of Computer-Based Education*” 12 (January, 1985) 59-68.

About Pearson Digital Learning

Pearson Digital Learning is the leader in proven, comprehensive technologies for preK-12 education. Our products include: the SuccessMaker® Enterprise and NovaNET® educational courseware systems, the KnowledgeBox® digital learning system; the Concert™ solution for integrated instructional management, assessment and decision-support; and the SASIxp® student information system. Pearson Digital Learning is also the exclusive distributor for the Waterford Early Reading Program™ and Waterford Early Math & Science™, adaptive computer-based instruction developed by the Waterford Institute.

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