

# Return on Investment and Technology-Based Training - An Introduction and a Case Study at Advanced Micro Devices

by Bijan Masumian

**ABSTRACT** - Return on Investment (ROI) is a legitimate concern of management in virtually all business sectors. For years, training departments in most U.S. corporations have had difficulty gathering substantive data on cost-efficiency of different approaches to training delivery. However, the growing popularity of technology-based approaches to training is quickly changing that. Today, with little effort, companies can digitally store a great deal of employee training data, generate valuable reports from these, compare the technology-based results with their classroom counterparts, and generate compelling ROI results for management. This paper presents a summary of such findings from nearly 180 different studies comparing classroom and technology-based approaches to training and the respective ROI data. The paper also offers information and initial ROI numbers on the use of technology-based training at Advanced Micro Devices (AMD), a global manufacturer of semiconductors.

## Growing Popularity of Technology-Based Learning

U.S. companies appear to be rapidly embracing technology-based approaches to delivering learning opportunities. *Training* magazine's 1996 Industry Report (September 1996) showed that 19% of all training in U.S. companies with at least 100 employees was delivered via computers. This included CD-ROM training and different forms of online training. A 1997 study by Omnitech Consulting Group showed that 16% of all training in the largest U.S. corporations was offered using computers. By the year 2000, this figure

was expected to more than double to 37%. Omnitech's study also forecasted that reliance on classroom training in the nation's Fortune 1000 companies would be reduced from 68% of all training in 1996 to 37% by the next millennium.

## Factors Contributing to Proliferation of Technology-Based Learning

Numerous factors have contributed to rapid deployment of technology-based learning methods in corporate America. Among these are the many advantages of technology-based approaches, including:

- Reduced learning time
- Lower costs
- Better overall learner performance
- Increased access to latest knowledge
- Increased opportunity for mastering content
- Learning in privacy
- Opportunity to explore potentially hazardous subjects without risk
- Increased learner motivation

### 1. Reduced Learning Time:

Unlike group-based learning in classrooms, where interruptions or digressions to other topics or ancillary materials can take place, well-designed technology-based methods present precise and focused content. Thus, nearly all comparative studies of Computer-Based Training (CBT) versus classroom training show some reductions in learning time for CBT.

In 1990, Fletcher analyzed more than 40 different studies in industry, educa-

tion, and the military. He found that across all studies, CBT courses resulted in approximately 31% savings in time compared to equivalent classroom instruction.

Gregory Adams (1992) reviewed six controlled studies conducted at different organizations including Xerox, IBM, and Federal Express. He found learning compression rates of 38%-70% for CBT over classroom instruction at these companies. Cantwell found 35% and 50% reductions for two CBT courses at Union Pacific.

In 1994, a Bradley Associates report summary of 30 studies showed reduced learning time of 50%. Hall's (1995) in-depth review of over 100 cases revealed CBT learning reduction times of 20%-80% with 40%-60% being the most common range. In one case, the semiconductor giant Intel replaced 8-12 hours of classroom training for learning software applications with 1-2 hours of online learning built into those software applications.

## 2. Lower Costs:

While the initial cost of developing a CBT course may be 3 to 4 times greater than a classroom course, a company can quickly recuperate those costs in delivery. The break-even point for a CBT course is often anywhere from 100 to 200 students. For an off-the-shelf course, this figure can be as low as 10 students. The larger the number of trainees for a given CBT course, the faster the company reaches the break-even point. Once the company passes that point, depending on the shelf-life of the course and the student population size, the savings can be very dramatic. For instance, Douglas (1991) reports that, in a 3-year period, IBM saved over \$100 million by converting some classroom training to CBT. During the 1990s, thousands of U.S. educational, industrial, and military organizations have saved millions of training dollars by adopting multimedia and online learning methods.

None of the surveys or meta-analytical studies have reported any decrease in learner achievement (knowledge retention or transfer) as a tradeoff for decreased time from using technology-based methods. In fact, most cases reported substantial increases in learning. For more on this, see the section on *Better Overall Perfor-*

*mance* below. The dollar impact of technology-based methods is discernable in at least two key areas:

- Savings in employee wages paid for training
- Savings in opportunity (productivity) costs

Consider these numbers for CBT savings in employee wages. Imagine a semiconductor company offers a 5-day course to 500 employees during a year. The average employee salary is a little over \$20 per hour (annual salary of \$33,000 with a 25% burden for insurance, FICA, etc.). Not counting possible travel costs and time, opportunity costs, or cost of creating, purchasing, and delivering training, the cost figures may look like this:

$$500 \text{ people} \times \$20/\text{burdened hour} \\ \times 40 \text{ hours} = \$400,000.$$

If all other variables remain equal, a typical 40% CBT reduction in time would save the company \$160,000 in wages for this training event alone. Although these are conservative numbers, in terms of most training budgets, these savings are still significant.

However, compared to opportunity (productivity) costs, savings in wages are very small. The average daily salary of semiconductor employees may currently be in the neighborhood of \$170.00. Companies expect employees to generate revenues of at least four times their salaries (\$800.00 a day) to be profitable. Thus, reducing five days of classroom training to three CBT days (a typical 40% reduction) for 500 semiconductor employees over a year would translate into productivity gains of \$800,000:

$$500 \text{ people} \times 2 \text{ days saved} \times \$800 \text{ day net} \\ \text{productivity cost} = \$800,000 \text{ savings.}$$

Adding the savings of \$160,000 in employee wages to the above productivity gains would reveal savings of almost \$1 million for this training event alone. If a large organization that annually offers thousands of hours of classroom training to its employees converts even a small percentage (e.g., 20%) of their classes to technology-based methods, the savings realized in both employee salaries and

gained productivity can easily run into millions of dollars. A case in point is AMD's training organization which, in 1998, offered over 216,000 hours of classroom and CBT training. These substantial savings are providing significant incentives for the larger U.S. corporations to convert as much of their classroom training to technology-based methods as possible.

### **3. Better Overall Performance:**

Adams study also found that CBT groups outperformed their classroom counterparts in the following areas:

- "Learning gains" were up to 56% higher for the CBT group.
- "Consistency in learning" was 50%-60% better.
- "Content retention" was 25%-50% better.

Studies have shown that the more a learner's senses are engaged, the higher the rate of learning, retention, and transfer of knowledge. We remember 20 percent of what we see, 40 percent of what we see and hear, and 70 percent of what we see, hear, and do. Well-designed interactive learning programs can provide a multi-sensory learning environment that enables us to learn and retain more information. Fletcher's (1990) study of the Institute for Defense Analysis found that interactive applications improved learner achievement by up to 25 percent over conventional training.

### **4. Increased Access to Latest Knowledge**

In today's fiercely competitive world, instant, continuous access to the latest knowledge is crucial to the survival of many companies. With the proper infrastructure, organizations can now use technology-based methods to provide the latest developments in different fields of knowledge and put that information at their employees' fingertips around the clock. This degree of accessibility and currency of information is simply not feasible in a classroom-dependent model of learning.

Also, continuous advances in both traditional and wireless telecommunications are virtually eliminating all geographical barriers for multi-national companies. Using internal networks (intranets), more and more corporations can now regularly and instantly update the content of their courseware around the globe by maintaining a single web server copy of each course. As soon as the server copy is updated, employees at all sites will have instant access to the updates. The survival value, cost-effectiveness, convenience, and immediacy of this method of updating information cannot be compared to the classroom model that relies on printing and distributing hard copies of training materials.

These organizations are also avoiding the costs and inconvenience of constantly contracting, scheduling, and sometimes canceling classes. In the semiconductor industry, delivering just-in-time (on-demand) learning opportunities is particularly crucial as many employees work in odd shifts, which makes scheduling after hour classrooms on a regular basis a daunting task.

### **5. Increased Opportunity for Mastering the Content**

Unlike a live classroom where teachers have to move at the pace of the average learner, technology-based methods allow employees to learn at their own individual pace and thus increase their chance of mastering the content. For instance, while in a classroom environment, it may not be feasible for the teacher to repeat a certain section of the presentation several times, in the CBT approach, the computer can present the same content over and over until the employee has mastered it.

### **6. Opportunity to Explore Potentially Hazardous Subjects Without Risk**

With technology-based methods, employees can explore potentially dangerous situations without subjecting themselves or others to physical harm and without exposing the company to losses due to employee injury, equipment damage, or lawsuits. This is important in the semi-



conductor industry where computer-based simulations that portray safe handling of chemicals or electricity can generate valuable learning without exposing humans to potentially hazardous situations.

### 7. Learning in Privacy

Unlike in classroom situations, most computer-based learners do not feel they are at an emotional risk by exploring areas that might cause embarrassment in group situations. They can also complete multiple reviews of the same content without feeling judged by others. CBT allows fast learners to master the content quickly without having to wait for the slower learners to catch up. By the same token, the slower learners can spend as much time as they need to master the content without feeling pressured by the faster learners.

### 8. Increased Learning Motivation

Richly designed, interactive multimedia applications that appeal to different senses can be highly motivating because they can appeal to the diverse learning styles of predominantly visual, auditory, or kinesthetic learners. Individualized programs can also reduce or eliminate potential distractions and disruptive behaviors that can occur in a classroom environment.

### Technology-Based Learning at Advanced Micro Devices

Advanced Micro Devices, a global manufacturer of semiconductors, ventured into technology-based learning in the second half of 1996 with the licensing of about 90 pre-packaged CBT courses from CBT Systems, Inc., a well-established CBT vendor headquartered in Ireland. In the fourth quarter of that year, AMD also released two internally developed CBT courses on hazard communication (Hazcom).

### Studies of Classroom versus Technology-Based Methods at AMD

In 1996, shortly after the first two internally produced Hazcom courses were developed by the author, he conducted two separate pilot studies of these courses. Both studies focused on reduction in training time. Results from the first pilot

revealed a 51% reduction in training time for the CBT course. While the classroom version of the course took an average of 96 minutes to complete, participants in the CBT pilot took an average of 47 minutes. As this was an OSHA-mandated course, all 4,000 AMD employees in Austin were required to complete the course annually. The large population along with the significant decrease in training time for the CBT course meant a potential annual savings of almost \$60,000 for the company, as shown in Figures 1 and 2.

These numbers, however, only reflected savings in *employee wages*. The *productivity gains* for the course would be roughly four times the employee wages. Thus, the total value of the potential annual savings for this course was approximately \$300,000:

$$\$60,000 + \$240,000 = \$300,000$$

Pilot results from the second course were even more dramatic. The CBT version of the course cut the average classroom time of 235 minutes (about 4 hours) to an average of 71 minutes - a reduction of 70%. However, the much smaller annual population of around 500 for this course meant a smaller annual savings of around \$19,000 in employee wages and about \$76,000 in productivity gains for a total savings of around \$95,000 per year, as shown in Figures 3 and 4.

### Expansion of the Technology-Based Model at AMD

These dramatic savings convinced AMD's Learning and Development (L&D) organization of the cost-benefits of the technology-based approach. Despite little time spent to promote CBT to AMD employees during 1996, by the year's end, employees had completed 369 CBT courses.

In 1997, the L&D organization expanded the presence of CBT by offering courses in four CBT labs situated in different buildings. Increased access, more systematic promotion of CBT, and the advantage of having courses available in easily accessible locations throughout the site resulted in more than 2,500 CBT course completions in 1997. The L&D organization also set an internal goal of providing 35%



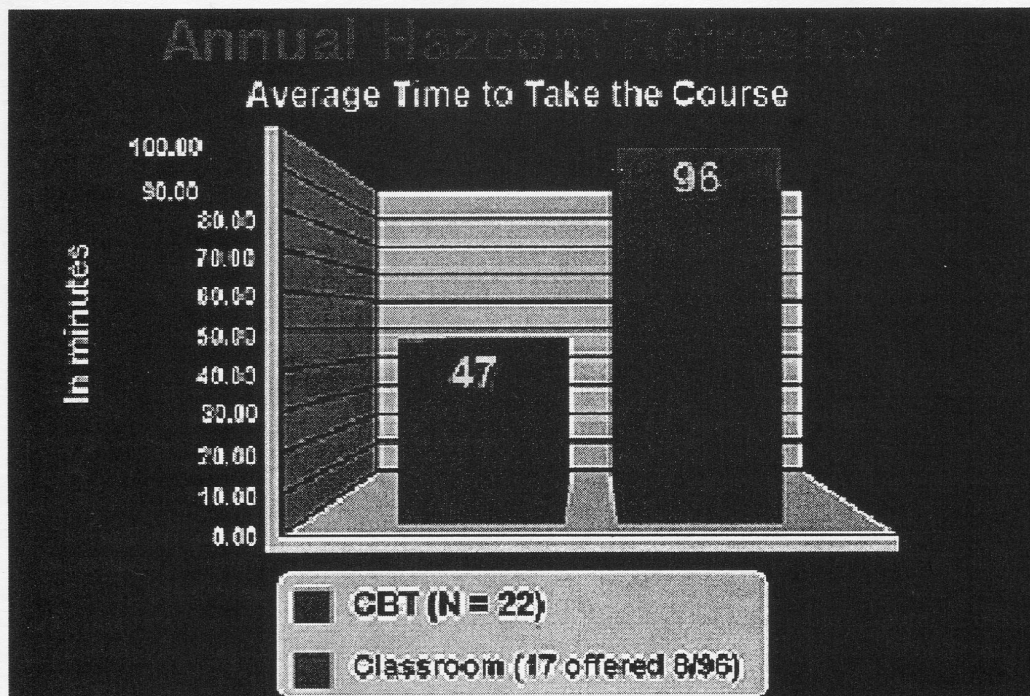


Figure 1

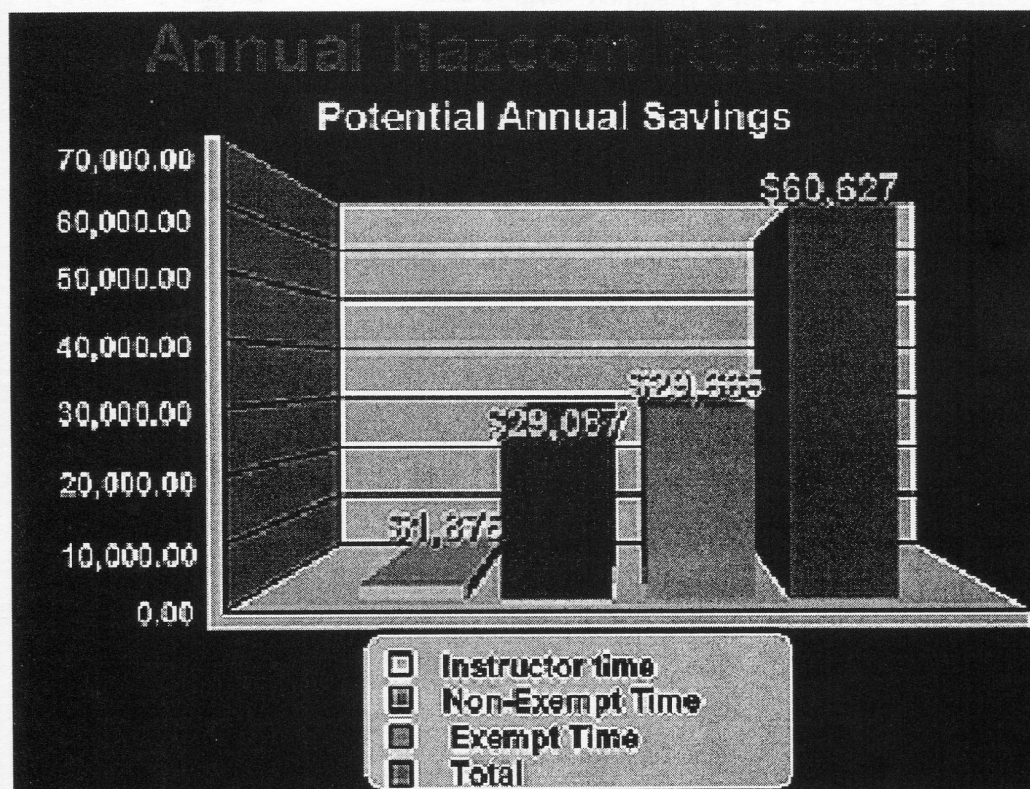


Figure 2

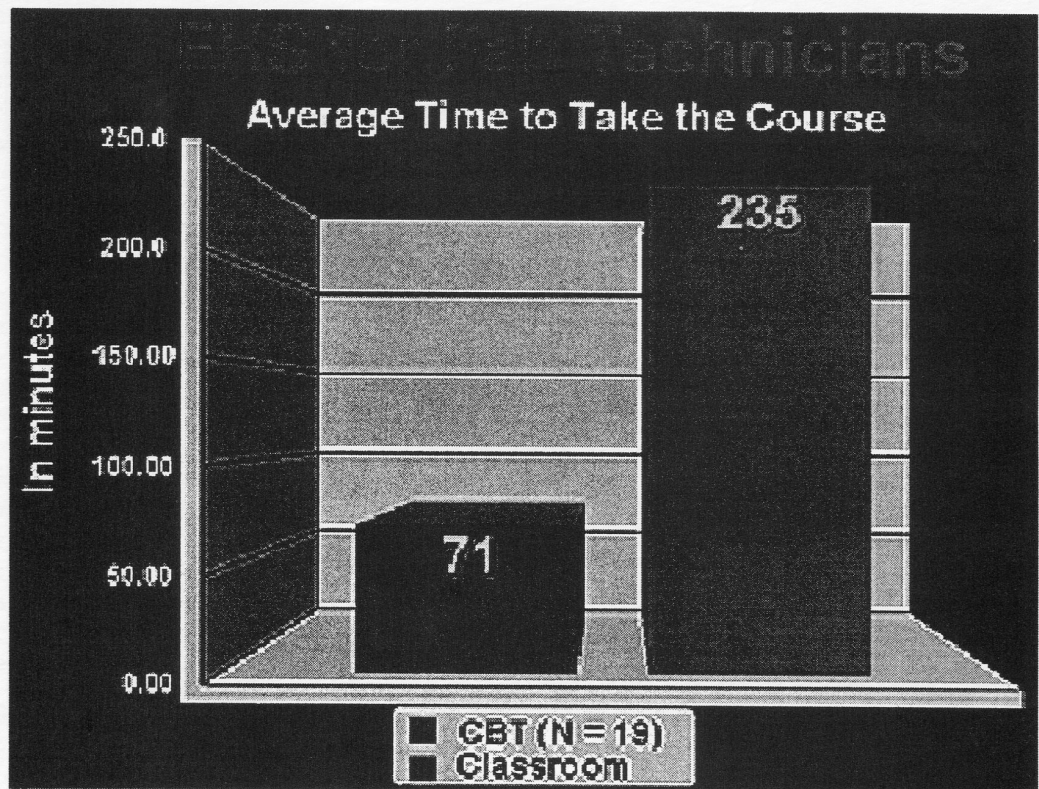


Figure 3

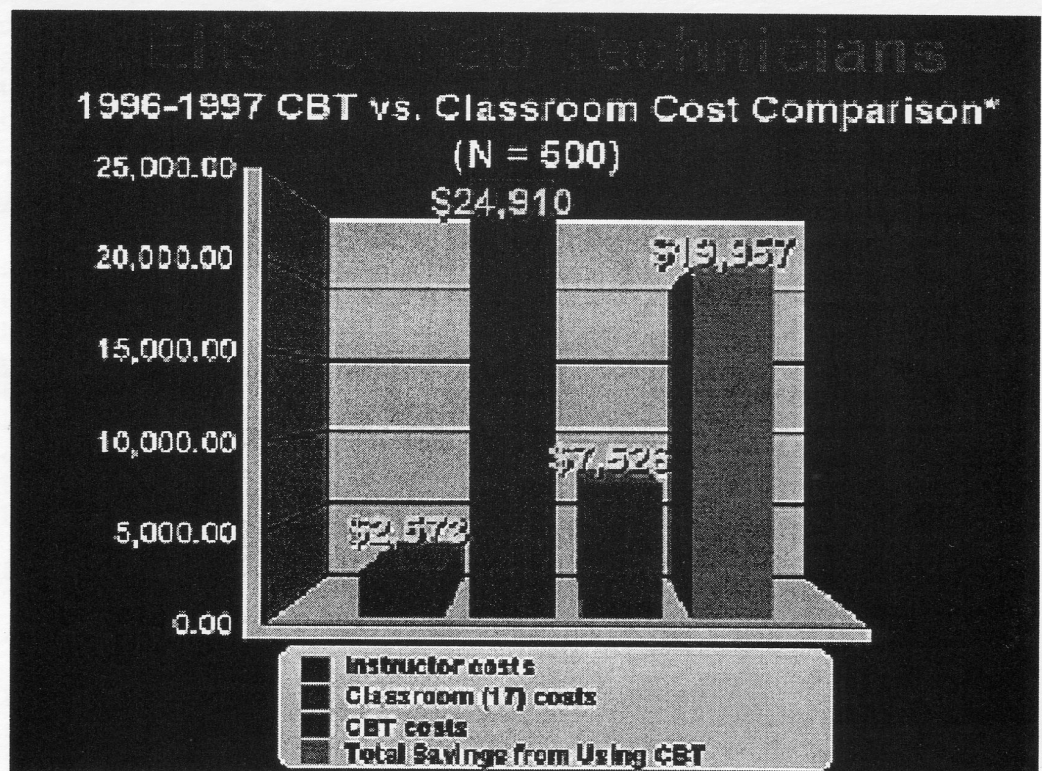


Figure 4



of all learning opportunities via electronic means by 2,002.

By 1998, L&D had begun offering "web-based version" of the CBT Systems courses as well as 12 internally developed web-based courses via its own web site. This provided all employees with uninterrupted network access to a huge library of web-based titles. As a result, during 1998, AMD employees completed 7,098 web-based courses or almost triple the previous year. Compared to their classroom counterparts, the shorter web-based courses saved the company 10,825 employee hours. The savings already realized in employee wages and productivity gains were as follows:

$10,825 \times \$20 = \$216,500$  (Wages applied to work, not class time)

$\$216,500 \times 4 = \$866,000$  (Productivity gains)

$\$216,500 + \$866,000 = \$1,082,500$  Total estimated gain from CBT

Table 1 below shows the organization's progress toward the goal of 35% electronic delivery of learning opportunities by the year 2002.

### On the Horizon

Like their counterparts in most Fortune 1000 companies, AMD's Learning and Development organization recognized the enormous potential of technology-based training. For the first time, the organization now has return-on-investment numbers that prove the cost-efficiency of this

delivery medium. In 1999, L&D will gather additional data on web-based learning, including data on student performance compared to classroom training.

A small, preliminary study revealed significantly less time on task and higher achievement scores for the web-based learning when compared to classroom. While the classroom version of a Microsoft Word course was slated for 4 hours, the web-based version of the same course took an average of 2 hours and 12 minutes for the participants to complete - a reduction in time of 45%. Student achievement scores were also obtained. In absence of a classroom test, the web-based test was slightly modified to ensure that both CBT and classroom groups were tested on the materials covered in their respective courses. The average CBT student had an achievement score of 89% compared to 64% for the classroom students, a 25% gain for the CBT students.

### Future

With support from AMD management, the company's new web-based learning model will continue to thrive in 1999 and beyond. The number of internally developed courses will continue to grow and dynamic electronic performance support (EPSS) tools are in the works for the front-line employees in the Fab 25 where the company's flagship K6-2 and K6-3 microprocessors are built. Additional studies that will yield more comprehensive ROI numbers will also be conducted.

Note: The author wishes to thank his colleagues Richard Knox and Adrienne

	1997	1998	Year-to-Year Gain
Number of classroom completions	27,101	23,215	-16%
Total CBT completions	2,549	7,098	178%
% of CBT vs. classroom completions	9%	28%	211%
Number of classroom courses available	329	262	-21%
Number of CBT courses available	75	168	124%
% of CBT courses available vs. classroom	23%	64%	178%
Number of new CBT courses introduced/evaluated	57	160	180%
Number of courses moved to pure CBT	3	9	200%

Table 1



Schmerbeck for providing him with valuable information for this study.

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### About the Author

**Bijan Masumian** has a Ph.D. in Instructional Technology from the University of Texas at Austin (1986). His professional experience includes working as the curriculum design specialist for Northland Pioneer College in Arizona and an instructional designer for the State of Texas. Since 1995, Bijan has worked as the lead Computer-Based Training (CBT) and Web-Based Training (WBT) developer for the Austin, Texas site of AMD (Advanced Micro Devices), a global manufacturer of semiconductors and a leading supplier of integrated circuits (ICs) for personal and networked computing and communications.

Bijan has designed numerous CBT and WBT courses as well as two highly touted intranets for the company, including a recently launched web site designed to address the professional development and performance support needs of almost 1,000 managers at AMD sites in the U.S. Bijan's articles on distance education have also been published in professional journals (*TechTrends* and *Educational Technology*).