Effective Vocational Computer-Based Training

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ABSTRACT

This paper discusses and describes innovative computer-based training/simulation software that has combined both the theory and practice into effective training solutions for vocational students in the context of the challenges of teaching vocational skills. These software packages can be used for open and distance learning in blended situations as well as supplementary materials in traditional classrooms, where there is access to computers. The benefits and costs of developing these materials will also be discussed. Research has shown that computers can effectively teach vocational skills. As well, research has shown that computer-based training can be used to take students to a higher level of skills in the same amount of lab/shop time or reduce the time needed to train students in labs/shops. At the British Columbia Institute of Technology, computer-based training has been used to train aircraft mechanics in how to make fewer errors, mechanics in how to take disassemble, assemble, and inspect aircraft engines, carpenters how to build roofs, plumbers how to troubleshoot hot water heating systems, plumbers how to test and troubleshoot backflow prevention systems, plumbers how to adjust the air/gas mixtures in furnaces, fish canners how to identify flaws in cans and the cause of those flaws, nurses how to handle patients with spinal injuries, doctors how to diagnose diseases, and teachers how to teach.

INTRODUCTION

It is obvious that vocational training is essential for rural and urban development. There are many strategies that are being done and have been done to provide vocational training. These include traditional lab/workshop facilities that are often found in post-secondary institutions and some secondary schools, partnerships with industry, and computer-based training/simulation software solutions. Given the large global need for developing vocational skills, more consideration should be given to creating computer-based training/simulation software for teaching vocational skills.

CHALLENGES IN PROVIDING VOCATIONAL TRAINING

Providing vocational training can be challenging for a number of reasons:

- Just-in-time learning may be required. For example, when instructors are hired in post-secondary settings, they are usually hired for their content expertise. All of the training that they need on how to teach is usually not available or possible to attain before they begin to teach. Demonstration software that teaches basic instructional skills can be downloaded from http://www.bcit.ca/appliedresearch/multimedia/downloads.shtml. If you are from a developing Commonwealth country, contact Dr. Krishna Alluri of the Commonwealth of Learning for freely using the full version of this software.
- Learners, especially those in rural areas, may not be able to travel to training locations. This is often problematic for learners who are only able to participate in distance education programs. Often, they are able to learn most of the theory online but only a small portion of the practical skills. Virtual labs/computer simulations can be used to teach some of these skills.
- It may be difficult to teach some of the theoretical components needed in vocational training. As an example, some skills require simulations for effective learning. One software program taught plumbing students how to test and troubleshoot backflow prevention assemblies (that are used to ensure a safe water supply). You can download a demonstration version of this software from www.bcit.ca/construction/plumbing/computertraining.shtml. This program reduced the time students needed in the lab for practicing the hands-on skills. In this case, the instructor used the extra time to enable students to reach a higher level of skills. Alternatively, given the lab was available, the instructor could have chosen to use the extra lab time to train more students. In another software project, carpentry students were taught how to build a specific type of roof. This

was problematic to teach because there were a large number of steps, detailed step-by-step visuals were needed, and the mathematics was complicated.

- Experts may be needed to teach advanced vocational skills. Given, these experts often have a full-time job, they may not have time to teach at all, especially if they have to travel to other sites. In one project, the expertise of nurses in spinal cord injury centre was captured on how to move and turn patients with a spinal injury. There is a free web download of this award-winning software from http://www.bcit.ca/appliedresearch/multimedia/downloads.shtml.
- Live training may have expensive costs. For example, costs (e.g., travel, accommodation, meals, time away from work, etc.) can be substantial when participants have to travel to a workshop. In one project, aircraft mechanics were trained to make fewer errors via a computer-based training CD-ROM in about one-quarter of the time needed in the live workshop. Travel costs were also saved.
- Equipment can be a limited resource for training many vocational skills. This is a common problem for teaching troubleshooting skills where one has to take components out of functioning systems, break them, put them back in, and let students determine the problem. This can be impractical because of the time it takes to remove, break, and install components as well as the cost of repairing the components later. This problem is compounded because this should be done to many components. As well, it would be ideal for each student to separately determine each fault. A simulation that addresses this type of equipment limitation taught plumbing students how to troubleshoot hot water heating systems. A demonstration version of this project can be downloaded from www.bcit.ca/construction/plumbing/computertraining.shtml. This instructional strategy can be applied to teaching vocational students other troubleshooting skills such as hydraulic systems within a factory or air conditioning systems in aircraft.

There is evidence to support that vocational skills, like the ones described above, can be taught via computer software (Chapman, 1985; Fenrich, 2002; Phillips, 1992; Raidl, 1993).

There can be other problems when teaching vocational skills in “live” situations:

- Students who miss activities, may not be able to do them later.
- Students typically can not repeat activities if something goes wrong.
- Some students, such as those in the back of a class, may not be able to clearly see demonstrations.
- The number of demonstrations may be limited due to time or cost considerations.
- Dangerous, expensive, or unavailable equipment or materials sometimes restrict learner activities.
- Some teaching materials are not effective. For example, a twenty minute videotape was created to attempt to train student mechanics how to take apart an aircraft engine and put it back together. However, this requires about 200 steps. A more effective resource would have included short step-by-step video clips and text explanations that can be accessed while the student was doing the steps.
- Media that is needed to teach vocational skills may not be easily shown when and where a student needs. For example, students may need to see photographs while they are working with equipment and materials.
- Equipment and/or media may not be available for testing students. Students are often tested on vocational skills through text, even though text may not be appropriate.

Through effective instructional design strategies, computer-based training/simulation can be used to address these problems. However, technology cannot be used to teach every skill that a vocational student needs. Imagine hiring a carpenter who has never held a hammer!

BENEFITS

A major benefit of using computers to teach vocation skills is that learners receive individualized instruction. With individualized instruction that is designed well, students can work at their own pace, proceed when they are ready, control their own learning path, and review as often as they want,

experience an infinitely patient tutor, be actively involved in their learning and have immediate feedback, be objectively evaluated, learn privately without peer competition, learn when there is a need, and learn when they want (Fenrich, 2005).

Practical benefits students can receive include significant increases in learning and retention while at the same time taking less time to learn the skills, participating in instructional strategies that are not possible in traditional settings, an alternative method to learn skills, and more interaction (when designed well) than in traditional settings (Fenrich, 2005).

Benefits of computer based training/simulation instructors, facilitators, and supervisors can receive include having a solution for teaching skills that they are not able to teach effectively through traditional methods as well as saving time through reduced teaching, marking, and preparation time (Fenrich, 2005).

The major benefit of computer based training/simulation for administrators is cost savings. Cost savings can be through reducing instructor time, the time employees are away from the job, travel and accommodation expenses (e.g., when employees are located at distant sites), fees (e.g., tuitions), and costs of using needed equipment for training instead of generating income (e.g., airplanes used for training cannot make money by transporting passengers) (Fenrich, 2005).

COSTS

As stated by Fenrich (2005), compared to creating traditional instructor-led training, creating computer based training/simulation tends to have higher developmental costs, particularly due to labour costs, require more expertise (e.g., instructional multimedia design, user-interface design, computer programming, video producers, and video editors), require specialized software, take longer to produce, have lower delivery costs, and have more sales potential, as it is reasonable to assume that if you have a training problem, others will also have the same training problem. One concern is that instructional multimedia design and user-interface design expertise is not readily available in both developed and developing countries. Evidence of this stems from the abundance of poorly-designed computer-based training packages.

Cost-effectiveness increases when there are larger numbers of learners (by decreasing the cost per student), the instruction is offered many times (by decreasing the cost per student), learners normally have to travel to receive their training, the material is stable with respect to content (the product can be used both now and in the future), and the materials can be inexpensively distributed, through the Internet, through an intranet, or via CD-ROM) (Fenrich, 2005).

Money can be saved by buying existing materials. However, these savings are reduced if modifications must be made or supplementary materials must be created.

SUMMARY

With respect to vocational skills, computer-based training/simulation software can be used to solve the need for just-in-time learning, provide a way of learning vocational skills through distance, teach difficult theoretical skills, make the knowledge of an expert available to others, reduce training costs, and provide a solution for limited or expensive equipment and materials.

Although there are numerous potential benefits that computer-based training/simulation software can provide to students and others, development costs can be expensive. However, over time this can be offset through training large numbers of students and selling the product.

There are many ways to provide vocational training. Given the large global need for developing vocational skills, the challenges of teaching vocational skills, and the capabilities of well-designed computer-based training/simulation software, more computer-based training/simulation applications should be developed for teaching vocational skills. However, regardless of the potential of using computer-based

training/simulation software for this, it is important to remember that students will still need hands-on experience.

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