
Learning via Gaming: An Immersive Environment for Teaching Kids Handwriting



The University of Michigan-Dearborn
Henry W. Patton Center for Engineering
Education and Practice

Henry W. Patton Center for Engineering
Education and Practice
Annual Progress Report

Learning via Gaming: An Immersive Environment for Teaching Kids Handwriting

(Project # 2006/6)

By:

Bruce R. Maxim, Associate Professor
Nilesh V. Patel, Assistant Professor
Department of Computer and Information Science

Table of Contents

Synopsis	iii
1. Background.....	1
2. Objectives.....	1
3. Approach.....	2
4. Results	3
5. Conclusions.....	3
6. Impact	
Educational	3
Industrial	3
7. Acknowledgments.....	4
8. References.....	4

Synopsis

Immersive learning using computer animation and simulation is an attractive concept. The use of immersive technology to deliver flying lessons to NASA astronauts is well known. While the efficacy of immersive environments for education and training is well established, their accessibility to elementary and middle school students is negligible. Until recently, hardware costs and long development times were two major factors impeding creation of such environments for younger students. Computing technology, specifically human machine interface development, has come a long way in the last decade. The authors are making use of this emerging technology to develop an immersive gaming environment to teach handwriting to elementary school children using a tablet PC delivery system.

1. Background

There has been a fair amount of research on user interface design for children [1, 2], error rates in text entry user interfaces [3], interactive teaching environments using Tablet PCs [4, 5] and using games as tools to promote learning in and out of the classroom [6, 7]. There has been very little research done on combining all of these elements into a tool suitable for teaching children how to write.

A tablet PC comes equipped with a touch screen that is designed to work with a pen input device or stylus [8]. Students can use the stylus to perform all functions found in an ordinary mouse, but more importantly, the Tablet PC allows students to use the stylus to write directly on the display screen. Interacting directly with the display screen provides users with an environment that is very easy to use [8]. Studies suggest that young children may have problems using the standard QWERTY keyboard as a compositional tool. There is some evidence that suggests children may write more easily using a Tablet PC than by typing on the keyboard [3].

Some teachers feel that computer games can motivate students to maintain their attention to the goals of particular learning activities. Many of these same people feel that games may enhance the classroom environment by allowing the teacher to play a less dominant role, and to not be forced to serve as the sole judge of student performance [9]. Games can be a powerful and pervasive way to take learning outside the classroom [6].

When playing a computer game, children may notice the multimedia content in the game, have fun interacting with game elements, and observe how easy some things are to learn [10]. There are several interface design issues that need to be addressed when creating game environments for children. Some of these include creating consistent and predictable user dialogs, offering informative feedback, providing simple error handling, and reducing the user's short term memory load [1].

Children learn at different rates, in different ways, and with different capacities [11]. Intelligent tutoring systems go beyond the limitations of traditional computer-based training systems [9]. Intelligent tutoring systems use information on a student's current and past performance to deliver customized content in a style best suited to the student's current instructional needs [12].

2. Objectives

- Establish a strong game design and development educational curriculum at the University of Michigan- Dearborn;
- Develop a strong research program in the field of immersive learning, providing a rich collaborative platform for experts in game development, multimedia computing, pattern recognition, and human computer interaction; and
- Develop a strong relationship with elementary schools for assessing the effectiveness of our software products and writing collaborative funding proposals for enhancing education via innovative methods.

3. Approach

The goal of this project is to create an immersive gaming environment using a Tablet PC that teaches children how to write using the D'Nealian [11] handwriting system. While playing the game, students are taught to write new letters as a means of opening reactive game elements. Students gain access to new game features by writing required key letters using the method taught. An intelligent tutoring system provides feedback on the children's work, telling them what they did right or wrong, and how to correct any errors made. Players progress through game levels with increasing difficulty as they work their way through the game world. Figure 1 shows a screenshot from the immersive game system.

The system design contains three key modules: (1) an interactive gaming environment where students play in a game environment to find hidden treasure, (2) a student writing evaluation and feedback module, and (3) a teacher evaluation and feedback module. Macromedia Flash is the implementation language for the computer animation in the game module. Microsoft C# is the implementation language for remainder of the system (including the user interaction and intelligent tutoring modules).



Figure 1. Student screen layout.

Figure 2 shows the architecture of the intelligent tutoring system. Our system incorporates a series of remediation rules developed by our research team working in collaboration with Donald Thurber, the creator of the D'Nealian handwriting system [11]. When implemented, the complete set of rules will allow for differences between fast and slow learners, girls and boys, and even left-handed and right-handed users. These rules, in turn, guide users through the game and help them develop their handwriting skills. Audio output and narrated animations are used to provide instructions and feedback to non-reading students.

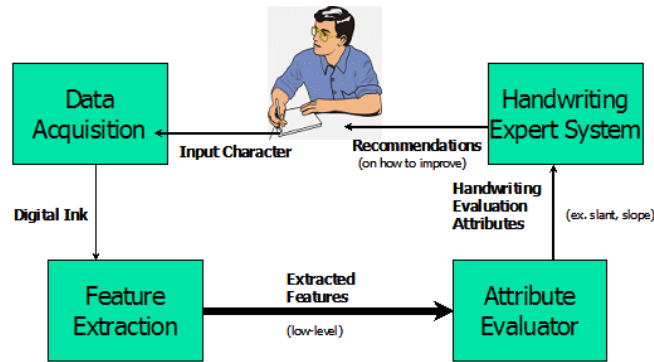


Figure 2. Intelligent tutoring system architecture.

4. Results

The authors have created a working prototype for the game environment and demonstrated the feasibility of using Flash and C# as a development platform. Sixteen senior and graduate level students studying game design at the authors' institution evaluated the prototype through play testing. These students used a five-point scale (1=poor, 5=excellent) to rate the prototype. Their average rating of the usability of the software is 4.9, the reliability of the software is 4.9, the entertainment value of the software is 4.5, and the quality of the game premise 4.7. The knowledge acquisition phase for the intelligent tutoring system is ongoing, as is the design of the knowledge base architecture.

5. Conclusions

The authors feel they have established the feasibility of using the Tablet PC as a delivery system for the game environment and intelligent tutoring system. Knowledge acquisition has proceeded more slowly than planned. The authors are working with Dr. Thurber to create an initial knowledge base for the intelligent tutoring system. The authors plan to begin testing the system with young children during in fall of 2007. Creation of art assets is a time-consuming process, and the authors plan to use students from a nearby art college to enhance the multimedia game library.

6. Impact

Educational

Students taking CIS 487/587 Computer Game Design and Implementation participated in the initial play testing of the evolving prototype of the immersive game environment during the Fall 2006 semester. The creation of the intelligent tutoring system knowledge base and its architecture will be used as case studies in CIS 479/579 Artificial Intelligence during the Summer 2007 semester.

Industrial

This project has the potential to open new opportunities in the educational gaming industry that is beginning to emerge in the state of Michigan. Several recent CIS graduates have found employment in

large California game studios, while at least one Michigan game development company has found it impossible to identify qualified candidates for open game programming positions.

7. Acknowledgements

The Henry W. Patton Center for Engineering Education and Practice provided the majority of the funding for this project. Additional funding was provided by Mandala Sciences. The team is deeply appreciative of the time and expertise contributed to this project by Dr. Don Thurber.

8. References

1. Read, J.C., S.J. MacFarlane, and P. Gregory. *Requirements for the Design of a Handwriting Recognition Based Writing Interface for Children*. ACM Press, 2004.
2. Read, J.C., S.J. MacFarlane, and C. Casey. *What's going on?: Discovering what Children understand about Handwriting Recognition Interfaces*. ACM Press, 2003.
3. Read, J.C., S.J. MacFarlane, and C. Casey. "Oops! Silly me! Errors in a Handwriting Recognition-based Text entry Interface for Children." *Proceedings of NordiCHI*, 2002.
4. Willis, C.L., and S.L. Muertschin. "Tablet PC's as Instructional Tools or the Pen is Mightier than the Board!" *Proceedings of SIGITE*, 2004.
5. Koile, K., and D. Singer. "Improving Learning is CS1 vial Tablet-PC-based In-Class Assessment." *Proceedings of ICER*, 2006.
6. Squire, K.D., "Changing the game: what happens when video games enter the classroom?" *Innovate*, 2005.
7. Aguilera, M., and A. Mendix. "Video Games and Education (Education in the Face of a "Parallel School")." *ACM Computers in Entertainment*, 2003.
8. "What is a Tablet PC?" *Microsoft*. 2007. Microsoft Corporation. 15 Jan. 2007 <<http://www.microsoft.com/windowsxp/tabletpc/evaluation/about.msp>>.
9. Siemer, J., and M.C. Angelides. "Evaluating Intelligent Tutoring with Gaming-Simulations." *Proceeding of Winter Simulation Conference*, 1995.
10. Druin, A., et al. "Children as our technology design partners." *The Design of Children's Technology*. San Francisco: Morgan Kaufmann, 1999. pp. 51-72.
11. Thurber, D.N. *D'Nealian Home/School Activities – Manuscript Practice for Grades 1-3*. Good Year Books, 1986.
12. Wegner, E. *Artificial Intelligence and Tutoring Systems*. Los Altos, CA: Morgan Kaufman, 1987.