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ABSTRACT

Games have long been used as instructional tools, but actual research examining that concept has been sparse. Increased sophistication and lower cost in hardware and software for personal computers has created a budding movement to incorporate computer games into learning environments. This paper discusses criteria for selecting an instructional game, which include simplicity, adaptability, potential for educational use, difference from other games in its category, and ability to be played by a single player. Games are grouped into eight categories: adventure games; arcade games; board games; card games; miscellaneous games; puzzles; simulations; and word games. The paper also describes some instructional applications of computer games, and describes a study in which 40 computer games were sampled by 40 adult participants; each game was played by two males and two females. An evaluator was present as the game was played. Researcher observation and follow-up interviews with the participants shed light on how differences in gender, learning style, and preferred problem-solving strategy affected the impact of the game on the individual learner. Results of the study showed that subjects felt that adventure, arcade, board, simulations, puzzles, and wordgames could be used for teaching problem solving and decision making. Most players felt that games containing violence had no place in education. Several players felt that the gambling scenarios depicted in card games were inappropriate for children, and should be limited to an adult population. A list of games used in the study and a list of suggested instructional benefits of various classifications of computer games are appended. (Contains 18 references.) (BEW)

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ED 394 500

Instructional Applications of Computer Games

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Background

The use of games as instructional tools is well established. There is evidence that games were used in China as early as 3000 B.C. Since the early 1960's there has been a rapid growth in the use of gaming and simulation in all areas of teaching. Children in elementary schools play word games. The military uses games and simulations in training. Medicine uses games to practice skills needed when assessing patient conditions. Business uses management games and simulations to create experiential environments for learning managerial behavior. For example, Faria (1987) has reported that 4,600 of the larger U.S. firms he surveyed used business or experiential games in training or development. Some wide ranges of benefits for which educational researchers and theorists ascribe to games include improved practical reasoning skills (Wood & Stewart, 1987), higher levels of continuing motivation (Malouf, 1988), and reduced training time and instructor load (Allen, Chatelier, Clark, & Sorenson, 1982). Diverse training applications, such as attention reduction or automaticity training (Jacobs, Dempsey, & Salisbury, 1990) and complex problem solving (Hayes, 1981), are hypothesized to be prime candidates for gaming strategies.

The actual research in the use of gaming for educational or instructional purposes is sparse. A review of some 100 instructional gaming articles (Dempsey, Lucassen, & Rasmussen, 1996) revealed little substantive research concerning ways that computer games could be used for educational purposes. The limited amount of study in this area has led some researchers (e.g., Bredemeier & Greenblat, 1981) to question many claims made on behalf of educational games because of lack of sufficient empirical support. Even so, games, particularly computer games, are considered by many to be powerful tools to increase learning. It seems almost self-evident that educational computer gaming is a growth area and one worthy of exploration by applied researchers. Despite findings that, for example, arcade-style gaming is a social and not an achievement oriented activity (McClure & Mears, 1986), gaming activity is increasing greatly because of more sophisticated and lower priced hardware and software in personal computers.

Educational researchers will be more frequently asked how to incorporate games into learning environments and will continue to be perplexed about how arrange studies that respond to this summons. Much of what occurs place in a gaming environment may not be easily measurable or, at least easily reduced to a few variables. The validity of the assessment of an instructional game is quite different from with other learning environments and, according to Reuben & Lederman (1982) is dependent on rules, interactions, roles, goals, and criteria.

Therefore, although experimental studies have an important place in the instructional gaming literature, there is a budding movement to recognize the limitations of objective-oriented research for assessment and look at the effects of incidental learning as well as intentional learning (Barnett, 1984; Remus, 1981).

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Purpose

The purpose of this paper, as the title suggests, is to discuss some instructional applications of computer games, particularly as they apply to adults. We will first offer a definition of games and propose a selection criteria for adapting existing computer games for education or training. Next, we will describe our study, over a two-year period, of adults playing relatively unsophisticated computer games. Based on preliminary analyses of the 160 observations in this study, we will discuss aspects of computer gaming particularly as they apply to gender and motivational influences, learning styles, game features, strategies used by adults to play, and applications of computer games to education. An enormous amount of qualitative and quantitative data was collected during the course of these observations. Parts of the data is still under study to uncover trends and patterns detected by multiple instruments across several of the 40 games observed in this study. Our focus therefore is not to present the study in all its particulars. Rather, we are here recording some of our perspective on instructional computer gaming and reporting aspects of our observations in particular areas.

What is a game?

Our experiences in playing, reviewing, and designing computer games; our prior reviews of the gaming literature; and discussions among ourselves and those in electronic research forums (e.g., PSYGAME) have led us to our present definition of a game.

A game is a set of activities involving one or more players. It has goals, constraints, payoffs, and consequences. A game is rule-guided and artificial in some respects. Finally, a game involves some aspect of competition, even if that competition is with oneself.

Most games are intended to be entertaining, not instructional. Often, the reason a person chooses to play a game is to experience the fun of engaging in the gaming activity. Learning is usually incidental, or intentional only for the purposes of one becoming a better gamer. The challenge for educators, therefore, is to take the learning that does take place in a game from activities, such as exploring a route through a maze or improving a motor skill on a keyboard, and apply that incidental knowledge or ability to an intentional learning task.

Educators have long advised that instructional designers look for existing gaming strategies when developing or adapting games for instructional purposes (see Driskell & Dwyer, 1984). The focus of our study, hence, was to probe for components or structures of existing computer games that would lend themselves for use in an educational or instructional setting. Concurrently, we wished to identify, primarily through observations and questionnaires, those attributes that were either motivating or distracting to adult players and to determine if these attributes tended to vary because of the gender of the player.

Game Selection Criteria

Our first task was to decide what criteria were most likely to make a game a good candidate for study. We selected five criteria.

To be more synchronous for intentional instructional purposes, a game:

(1) must be relatively simple to play;

This criterion arises from our belief that gaming used for instructional purposes

should not be overly complex. Complex rules and scoring require the learner to use limited learning time to understand the game (Jacobs, & Dempsey, 1993). An exception, would be a game that is intrinsically motivating and directly related to the intended learning outcome. We define an intrinsically motivating instructional game as one in which game structure itself helps to teach the instructional content.

(2) Can be adapted and reprogrammed cheaply;

To maintain a reasonable cost-benefit, the value of resources that must be sacrificed to gain benefits or effects must be comparatively less than the value of the benefits or effects themselves (see Levin, 1983).

(3) must have some identifiable potential for educational use, if adapted.

Here we liberally interpreted "potential" to be any reasonable possibility of applying the game to education or training. For example, card games such as "Acey Ducey" require some arithmetic skills and therefore have some potential for intentional educational use and application to specific learning outcomes.

In addition, for the purposes of our study, we decided that a game:

(4) must be different from the other games in its category;

In order to study as many kinds of games as possible.

(5) must be able to be played by a single player.

This was an arbitrary decision. One person is the lowest common denominator in computer game playing and we felt that it would be less confounding to restrict our study, at this point, to a single players. Many of the games we reviewed could be played by either one or more than one player. One of the frequent comments made by players during game play is the wish to collaborate or, more frequently, to compete with another human player.

Subjects

Forty adults, 20 females and 20 males, participated in the study. Ages of participants ranged from 18 to 52. All volunteered to participate. Educational achievement was rather evenly divided among high school, college, masters, and doctoral degreed individuals. Most were moderately to very experienced using computers.[1] A majority subjects reported that they enjoyed playing games. Slightly fewer adults reported that they enjoyed games which use computer technology.[2] Although the numbers of games (of any kind) played per month was relatively balanced between males and females, males played technology games more often and in greater frequency than did females.[3]

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[1] Eighty-eight percent of all participants reported that they were moderately to very experienced using computers.

[2]Sixty-seven percent enjoyed playing games (30% neutral). Adding technology (e.g., computer games) to the game-playing experience, changed these percentages only slightly (63% liked to play; 30% neutral). Only about 4% of the participants disliked game-playing in any form.

[3]The numbers of individuals playing occasionally (1 to 3 games per month) was evenly matched (33 each). Males in this study, however, played technology-based games more frequently. Of those reporting that they played 10 or more games per month, 28 were males versus only 8 females.

Only a small percentage of participants reported that they played no games at all per month.[4] The number of adults playing no technology-based games, however, was double that amount. Slightly over half of the participants reported that they were competitive or very competitive when they did play games. Respectively, subjects were most experienced playing card games, board games, puzzles, and word games.[5]

Materials

Forty computer games were used in this study (see Figure 1). The largest selection of games came from a collection of games entitled MACnificent 7.1 — Education & Games CD-ROM (1993). By preference, we adopted the eight divisions the producers of that CD-ROM used to categorized games. These categories consisted of puzzles, adventure games, board games, simulations, card games, arcade games, word games and miscellaneous games. Some of the games used color and others were black and white. Each category was comprised of five games serving as a sampling of the variety of games found in each area. Each game was played by two females and two males. Ten packets containing four games each was randomly assigned to the 40 volunteers (160 observations).

Instruments

A Demographic and Gaming Experience Questionnaire was used to gather information about the subjects' age, gender, and educational experience. It includes a scale related to the subjects' predisposition toward game playing, technology-based game playing, frequency of game playing, and frequency of technology-based game playing. Kolb's Learning-Style Inventory was implemented to look for patterns in participants' experiential styles and game preferences. The CAS-Q questionnaire (Seligman) was administered in this study to measure subjects' degree of optimism and compare that to observations of their game playing behavior. Experimenter observations were recorded for each gaming experience on a two-page observation protocol. Finally, two gaming scales were specifically developed for this study and were administered after each game. The first was a modification of Keller's Instructional Motivational Scale. The scale includes statements related to attention, relevance, confidence, and satisfaction specifically oriented toward computer gaming. The second gaming scale, was derived from articles from the gaming literature review. The areas analyzed from this scale included: challenge, fantasy, curiosity (Malone, 1981); fidelity, artificiality, interactivity (Duchastel, 1991); Complexity (Jacobs & Dempsey, 1993); and control (Westrom & Shaban, 1992).

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[4] Forty-seven percent of the subjects reported playing 1 to 3 games per month, 17% reported playing 4 to 6 games, 6% played 7 to 9 games, and 8% played 10 to 12 games. Only, 11 percent played no games at all.

[5] Of the eight game categories considered in this study, participants reported being experienced or very experienced to the following extent: card games (78%), board games (56%), puzzles (52%), word games (48%), miscellaneous games (28%), simulation games (22%), adventure games (19%), and arcade games (8%).

Procedure

Subjects received information concerning the purpose of the study. They were asked to complete a demographic and gaming experience questionnaire, as well as the Kolb and Seligman scales mentioned above. Following the surveys the subjects were given verbal instructions on how to play the game selected and to comment freely during the game play about feelings and strategies. An evaluator was present as the games are played. The evaluator assumed a participant-observer role recording observations and comments during the play. Specific areas of interest and concerns were defined prior to the actual commencement of the game playing segment of this study. After each game observation, follow-up sessions were conducted as a means of stimulating discussion about the game play. In addition to the follow-up interview, the subjects completed ARCS Gaming Scale and the second scale derived from articles from the gaming literature review. Most of the observations took place on a computer with a color monitor in an isolated university office.

Gender and Motivation

The most diverse patterns between males and females occurred in simulation gaming. Females in this study may have been less motivated to engage in the simulation games because the games did not capture their interest or attention. For example, females stated that the screen designs were boring and there was not enough screen variety in the simulation games[6,7].

Challenge is usually considered to be an important component of motivating game play for engaging in game play. More females than males felt it was not important to complete simulations successfully[8]. It may be that males were more challenged by simulation games than females. ~~Interestingly, of all eight game types, the highest percentage of~~

Subjects did not have a high level of confidence for success in any of the game categories. Again, there were some differing trends for males and females observed for simulation games. Females were much more likely than males to say that they were not confident that they could succeed during simulation games[9]. Subjects of both sexes felt that they were not in control of simulation games.[10] On the other hand, both females and males

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[6]60% of females stated "mostly true" and 60% of males stated "not true" for boring screen designs.

[7]60% of females stated "not true" and 40% of males stated "mostly true" for screen variety to keep their attention.

[8]50% of females stated "mostly true" and 50% of males stated "not true" in response to the statement, "Completing the game successfully was not important to me."

[9]60% of females and 20% of males stated "not true" that they were confident they could succeed.

[10]65% of all subjects felt that they were not in control of simulation games.

did not indicate that they found simulation games to be too difficult.[11]

A much larger percentage of females than males expressed a dislike of violent or aggressive games.[12] A sizable percentage of men felt that the more active categories of games were "male" games.[13]

Learning Styles

Subjects in this study covered all four quadrants of the Kolb's learning styles. A larger percentage of females were accommodators and divergers. Males comprised a larger percentage of convergers and assimilators[14].

Many of the learning style patterns that were observed or reported by the subjects may have been due in part to gender differences. For example, accommodators, with a larger percentage of females were less competitive[15] and less likely to be experienced using simulations[16], and were generally more pessimistic on Seligman's CAS-Q Scale than were the other learning groups[17]. Although we have some initial results regarding the way different learning styles play games, we have decided to reanalyze the data, controlling (where possible) for the effects of gender.

Features

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[11] 40% of females and 50% of males stated "not true" that the game was always too difficult. 10% of females and 20% of males stated "mostly true."

[12] 67% of females did not like warlike aggressive games.

[13] Over 40% of the males felt that the adventure, arcade, board and simulation games were male-oriented games.

[14] Accommodators 23%(78% female, 22% male);Divergers 23% (67% female, 33% male); Convergers 23%(33% female, 67% male); Assimilators 33% (31% female, 69% male).

[15] Assimilators appeared to be most competitive (77%), while Divergers tended to be least competitive (78%). Less competitive divergers tended to be female. There appeared to be no sex difference for assimilators.

[16] Accommodators and Divergers were least likely to be experienced with simulations and tended to be female. One–third of Convergers and Assimilators indicated being experienced to very experienced and these respondents tended to be male.

[17] Divergers scored equally as "average" or "very pessimistic" (33% respectively). 38% of Assimilators scored "very pessimistic" while 31% were "moderately optimistic."55% of Convergers tended to be "very pessimistic." 67% of Accommodators were more likely to be "very pessimistic."

Qualitative data, especially, show many key features that subjects regard as essential for a good gaming environment. Three main concerns were, first, the need for clear, concise instructions describing how to play the game. Secondly, the game should be challenging. Third, the player should have control over many gaming options such as speed, degree of difficulty, timing, sound effects and feedback. Each of these concerns was listed in all eight of the gaming categories.

Aesthetic issues, such as screen design, color, text, action, animation and graphics quality were considered important as well.[18] The need for opportunities for success was isolated as an area of concern in all gaming categories except adventure, arcade and board games. Subjects felt that clear goals and objectives were needed in adventure, board, card games and simulations.

An overview of player position was considered an important feature in adventure games. A desire for variety was expressed in arcade games. Players reported that help functions, hints and examples were necessary in adventure, miscellaneous and word games. Some games contained an element of mystery, intrigue and suspense. These characteristics were pleasing to some players. Many liked the idea of games with familiar scenarios or stories.

Subjects did find certain features to be distracting. Violence was seen as distracting in arcade games and simulations. Lack of goals, instructions, control and interactivity across all game types were a main source of frustration for many of the players. Many of the games used in this study were typical shareware games lacking in three dimensional color graphics. The subjects found the screen designs to be boring. They remarked about the lack of color in some of the games and the lower sophistication of some of the screen designs.

Strategies

In this study, strategies in playing computer games included trail and error, reading instructions, reliance on prior knowledge or experiences and development of a personal gaming playing strategies by the subject. Trial and error was , by far, the predominant strategy used[19] even in cases where subjects reported that they know a more efficient strategy.

Trial and error in computer gaming is defined as the absence of a systematic strategy in playing a game. This particular strategy involves actions and reactions to circumstances, consequences and feedback within the game framework. Knowledge of how to play the game is accumulated through observation and active participation in the gaming process, not by reading rules and instructions. Trial and error was the dominant strategy used across

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[18] Color, screen design, appropriate use of sound and feedback were listed in 87.5% of the gaming categories.

[19] The breakdown of strategies used was:

126 of 160 games played used trial and error (79%)
12 of 160 games played read instructions (8%)
6 of 160 games played used prior knowledge (4%)
13 of 160 games played using personal strategies developed by subject. (8%)

all game types[20].

People playing puzzles read instructions more than those playing other games.[21] Subjects were also observed using visual imagery techniques when playing the puzzle games.

Personal strategy development included visual imagery (puzzles), note taking (simulation), memorization and pattern matching (miscellaneous games involving sound), use of help, hint and game tools (adventure, board, puzzle, simulations) and systematic use of alphabet characters (word). The amount of experience a subject had in playing a particular game did not appear to influence the amount of time spent in game play.[22]

Applications

Subjects were asked how they thought particular computer game formats might be used in an educational/instructional setting. Their suggestions for use for each of the eight game categories is summarized in Figure 2. Although many of the responses were specific for the topic of the game for which they had most recently engaged, some subjects offered suggestions which were more general in nature. It was felt that adventure, arcade, board, simulations, puzzles and word games could be used for teaching problem solving and decision making. Many of the computer games could be constructed in a manner to address particular topics. Depending on the learning outcome desired, one type of game may be more suited than another.

There were specific games that subjects felt did not have a place in an educational setting. Most players, male and female, felt that games containing violence had no place in education. Several card games depicted a gambling scenario. Several players felt this was inappropriate, especially for children. Because the highest suggested use of card games involved instruction in probability and risk calculation, perhaps this type of game should be limited to an adult population.

Discussion

Computer games can be very complex, particularly simulation and adventure games. Arcade, card and word games are based on a more simple structure. Each of these eight categories of games has potential for educational or instructional use. Whether verbal information, motor skills or intellectual skills are the object of the instruction, computer games can be designed to address specific learning outcomes.

Based on the data collected from this study, it appears that specific features a game displays are of the some importance. Players want clear and concise instructions,

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[20] Trial and error was used 100% of the time in arcade games. It was used least in puzzle games - being used only 55% of the time. All of the remaining games fell within the 55 to 100 % range.

[21] 30% (6 of 20) of the subjects playing puzzle games took time to read the instructions. Simulation and board games had 10% of its players reading instructions.

[22] Arcade games had the least amount of time engaged in game play. (11 min) Simulations had the highest amount of time engaged in game play. (22 min)

challenging games, control over gaming options such as speed, difficulty, timing and help functions. Screen design, color action and appropriate use of sound and feedback are also desired. Because of the availability of fast action, multifaceted computer games on the market today, games lacking the features listed above may not keep a player engaged a significant amount of time for learning to occur.

Over 79% of the subjects in this study used trail and error as their game playing strategy. We feel that this choice of strategy was due to several reasons related to what the subjects themselves expressed as being important: lack of clear instructions, goals of the game not being defined and the desire on the part of the subject to discover the object of the game while playing the game. Oftentimes, the subjects would begin playing the game using trial and error and then would look for guidance by reading instructions or hint screens. As a result, computer games in an instructional setting should be constructed to allow for discovery learning, but clear and concise instructions and goals should be available for the player to access if needed.

It also appears that clear and precise instructions are required to encourage game players to proceed with a game. Likewise, a statement of goals and objectives are important to encourage engagement in a game. Often, game players were frustrated when they were unsure of the game's objective.

Providing examples of how to play the game, winning prototypes, can facilitate engagement in a game as well as incidental learning. Similarly, game players could acquire winning prototype learning strategies which would transfer to other learning tasks. In a "dog eat dog" economic simulation game used in this study (MacNasty), a framing strategy could clearly organize the details of the game action and maximize the players opportunities for success. Once learned this strategy could transfer to intentional academic goals requiring problem organization or establishing relationships through logical inference.

Aesthetic issues, such as screen design, color, text, action, animation, and graphics quality were considered important by the adult players. For example, color, screen design, appropriate use of sound and feedback were listed as very important to sustain interest in the game in 87.5% of the games studied.

Increased confidence encouraged adults to continue a game of skill. Where confidence was low persistence was short-lived. Aspects of confidence, personal control and self-attribution, was perceived as highly lacking especially by females[23] for certain types of games. Consequently, success, particularly positive consequences, was frequently observed as an indicator of satisfaction with the game[24].

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[23] Overall, 46% of females and 22% of males felt that when they succeeded, they were lucky.

[24] Again, females were noticeably less satisfied with the computer games. Overall, 50% of females versus 32% of males did not feel they got much out of playing the game.

References

Allen, J.P., Chatelier, P., Clark, H.J., and Sorenson, R. (1982). Behavioral science in the military: Research trends for the eighties. Professional Psychology, 13, 918-929.

Braun, C.M., Goupil, G., & Giroux, J. (1986). Adolescents and microcomputers: Sex differences, proxemics, task and stimulus variables. Journal of Psychology, 120 (6), 529-542.

Bredemeier, M.E. & Greenblat, C.E. (1981). The educational effectiveness of games: A synthesis of findings. Simulation and Games, 12 (3), 307-332.

Dempsey, J.V., Lucassen, B., Gilley, W., & Rasmussen, K.(1993-1994). Since Malone's theory on intrinsically motivating instruction: What's the score in the gaming literature? Journal of Educational Technology Systems, 22 (2), 173-183.

Dempsey, J.V., Lucassen, B., & Rasmussen, K., (1996). The Instructional Gaming Literature: Implications and 99 Sources. Manuscript submitted for Publication.

Driskell, J.E. and Dwyer, D.J.(1984). Microcomputer videogame based training. Educational Technology, 24, 11-17.

Duchastel, P. (1991). Instructional strategies for simulation-based learning. Journal of Educational Technology Systems, 19 (3), 265-276.

Faria, A. J. (1987). A survey of the use of business games in academia and business. Simulations and Games, 18 (2), 207-224.

Jacobs, J.W., & Dempsey, J.V.(1993). Simulation and gaming: Fidelity, feedback and motivation. In J.V. Dempsey & G.C. Sales, Interactive Instruction and Feedback. Englewood Cliffs, NJ: Educational Technology Publications.

Jacobs, J.W., Dempsey, J.V., &, Salisbury, D.F. (1990). An attention reduction training model: Educational and technological implications. Journal of Artificial Intelligence in Education, 1 (4), 41-50.

Levin, H.M. (1983). Cost-Effectiveness: A Primer. Newbury Park, CA: Sage Publications

MACnificent 7.1 — Education & Games CD-ROM [Computer Software]. (1993).Grand Rapids, MN: Wayzata Technology, Inc.

Malone, T.W. (1981). Toward a theory of intrinsic motivating instruction. Cognitive Science, 4, 333-369.

Malone, T.W. (1981b). What makes computer games fun? Byte, 6, 258-277.

Malouf, D.B. (1988). The effect of instructional computer games on continuing student motivation. The Journal of Special Education. 21 (4), 27-38.

Remus, W.E. (1981). Experimental designs for analyzing data on games: On even the best statistical methods do not replace good experimental control. Simulation and Games, 12(1), 3-14.

Westrom, M., & Shaban, A. (1992). Intrinsic motivation in microcomputer games. Journal of Research on Computing, 24 (4), 433-445.

Wood, L.E. and Stewart, R.W. (1987). Improvement of practical reasoning skills with computer skills. Journal of Computer-Based Instruction, 14(2), 49-53.

Figure 1. Games Used in Study

Eight categories with five games per category (total 40 games) were chosen for the study. The games chosen were originally designed to be entertaining, not instructional.

Card Games
Vagas Poker
Pyramid
Mac Jack
Red Dog
Acey-Duecy

Arcade Games
Save the Farm
Bloodsuckers
Maelstrom
Glidor
Gang War

Word Games
Lembracs
Hyper Jotto
Cryptogram
Flash IQ
Mac Triv 3.0

Miscellaneous
Test of Minds (color)
Bird Race
Concentration
Flec Family
RePete

Puzzles
Mazer 3D
Color Rhodes
ICON Quest
Faculty Towers of Hanoi
Number Fubar

Adventures
Scarab of RA
Camel
Quest of a Quert (Red Readers)
Murder in the Stacks
Save Princeton

Board Games
Think Ahead
Influence
Five Stones
Susan
Battle Cruiser

Simulations
MacNasty
Assault II
Cannon Fodder
Rescue
Wall Street 2.0

Figure 2: Suggested Use of Computer Games in an Educational Setting

Adventure games

Survival Skills
Inventory
Supply & Demand
Probability
Consequences
Problem-solving
Navigating
History
Purchasing
Budgeting
High-order thinking skills
Learning verbs/nouns
Spelling/writing

Arcade Games

Hand-eye Coordination
Reflexive Action
Motor Skills
Speed Simulations
Multiple problems/priorities
Timing
Angles, trajectories
Air current
Planning
Decision making

Board Games

Budget
Logic Strategy
Counting
Planning
Problem-solving
Deductive reasoning
Critical thinking
Coordination
Navigation

Card Games

Probabilities
Calculate Risk
Develop Strategies
Addition
Pattern Recognition

Miscellaneous Games

Logic
Pattern Recognition
Short-term Memory
Learning Alphabet
Probabilities
Pattern Matching
Audio/visual discrimination

Puzzles

Planning Strategies
Thinking Ahead
Spatial Orientation
Map reading
Architectural Design
Problem-solving
Hand-eye coordination
Pattern recognition
Matching
Assembly/disassembly

Simulations

Writing Fiction
Teaching Framing
Tactical & Strategic Planning
Coordinates
Velocity, speed, wind, angles
Decision Making
Consequences
Economics/Stock Projections

Word Games

Vocabulary
Spelling
Problem-solving
Remediation
Verbal Information
Drill & Practice
Reinforcement