The Contribution of Virtual Reality Software to Design in Teaching Physical Education

Esther ZARETSKY

Giv'at Washington Academic College of Education

D.N. Evtah, 79239, Israel

ABSTRACT

Up to date research shows that training with virtual software develops the design of virtual simulations by physical education pre service teachers. The design of virtual simulations improved spatial skills, especially visualization of the body's movements in space. The present research is aimed at testing and developing physical education pre service teachers' awareness of the connection between the virtual simulation design and physical education activities. This is done by using Tetris software, consequently improving lesson planning. The study design focused on a qualitative research using a post-test open ended questionnaire for getting the participants' opinions, and comparing the pre service teachers' performance of virtual simulation design before and after the training with the Tetris software. The findings showed that as software use increased, the connection between the design of virtual simulations and physical education became clear to the pre service teachers. Also the pupils became involved in the virtual simulation design. Using computer presentations in their practical work, the pre service teachers reported improvement in pupils' physical skills. Moreover, the pre service teachers' motivation was enhanced. All the findings lead to the conclusion that virtual simulations design seem to mediate between developing physical skills involving running, jumping, etc. and spatial intelligence.

Keywords: Design, Delight, Dynamic, Manipulation, Physical Education, Practical Work, Software, Virtual Reality, Virtual Simulations and Visualization.

1. INTRODUCTION

Recently, research on the connection between the design of virtual simulations and physical activities has been developing (1) (2) (3) (4) (5) (6) (7).
Seemingly, these two areas are contradictory since most physical educators do not associate virtual simulations with physical activities, but with science (8), medical imaging (9) (10) (11), computer games (12) (13), etc.

The virtual simulation design enables pre service teachers to illustrate sequences of movements while changing body positions and perspectives. Consequently, they perceived the process by which the movements are performed (14), as the virtual environment simulates the learner's natural environment. Virtual simulations offer pre service teachers the unique opportunity to observe and manipulate normally inaccessible objects, variables and processes in real time and design it appropriately (2) (15).
The illustration of objects makes learning more straightforward and intuitive for many students and supports a constructivist approach to learning. Students can learn by doing rather than, for example, reading about them. They can also testify theories by developing alternative realities. This greatly facilitates the mastery of difficult concepts, for example, the relation between distance, motion and time (8). Manipulating the body or the objects virtually help the students to understand the process of performing physical acts by sequentially (14). Physical manipulations that are complicate to perceive or to measure in usual experiments can be presented in a virtual world and viewed in many different perspectives in a virtual reality laboratory. Virtual reality technology allows the participant multisensory experiences coming from perceptual information visual, auditory, and tactile stimuli. According to Pizer (as cited in Reingold (16)) the main advantage of Virtual Reality regarding perception is the ability to move and change our view of things as we would do in the real world in order to give us an adequate perception. Virtual Reality technology is developing interfaces that mirror more natural human behaviors and the given physical laws governing the objects they interact within the environment. Dynamic Simulations allow visualizing complex dynamic processes (17). Visualization enables us to show information that would otherwise not be available (18).

The research of augmenting virtual environment examined three spatial training displays: first-person view, overhead-map view or first-person view with integrated map (composite view). Participants learned the locations of seven targets in a computer simulation of a building. Spatial knowledge for these targets was assessed in the physical building. Results indicate that both the type of training display and spatial ability predicted performance level and that the utility of the composite display was a function of spatial ability and task. Success in navigational learning from the simulated

environments is depended on a complex interaction between spatial ability, navigational task, and type of training display (1).
The individual needs his spatial intelligence for his body's movement and computerized activities, for example: while using the computer, he is required to move an object through the maze to a marked target. But in body movement, he must run through the course without bumping into barriers or obstacles.
The integration of physical and virtual movements improves spatial intelligence (14) (19).
The main similarities between virtual simulations and physical activities are as follows. Both experiences include initiated motor activities and require inter-sensory coordination; both experiences refer to the basics of the motion: body, space, time, power and flow.

The virtual (computerized) activities also differ from physical activities in some aspects (see Table 1).

Table 1: The Differences between virtual Activities and Physical Activities.

Virtual Activities	Physical Activities
Performed by fingers – fine motor.	Done by the whole body – gross motor.
Based on visual perception.	Based on kinesthetic perception.
Can be done individually or communicatively.	Serves usually also as a social event.
Focuses on information appears on the computer screen.	Relates to the environment

2. THEORETICAL REVIEW

Up to date research shows that virtual software for developing spatial skills enables learners to both develop and improve academic achievements (5) (20) (21) (22).

The Tetris Software

Pazhitnov (23) invented the Tetris Software in 1985. Since then, this software (computer game) was considered as the hardest task exemplifying problem solving by manipulating virtual reality, while the users race to fit falling blocks together. In the game, the player sees the shapes' aggregates graphically and tries to organize them before they fall (20). It links the concrete and the symbolic by means of feedback. The manipulations of the shapes' aggregates over the computer screen (rotating them to the right or to the left side) link the symbolic commands to a sensory-concrete turning action (24). The game exploded in popularity after Nintendo Co. and people put it on their popular gaming machines.

Tetris Software and Virtual Reality

Virtual-simulated environments are becoming more and more realistic, offering a real-world experience. Pantelidis (25) defines Virtual Reality (VR) as a multimedia interactive computer-based environment that allows the user to assimilate and become an active partner in the virtual world. The technology enables presenting information in three dimensional formats in real time (26) (27). Through virtual reality learning environments, the users can control time, scale and physical laws. The users have unique capabilities such as the ability to fly through the virtual world, to occupy any object as a virtual body. To observe the environment from many perspectives is both a conceptual and a social skill: enabling pupils to practice this skill in ways we cannot achieve in the physical world is a valuable attribute of virtual reality.

The Tetris Software focuses on visualizing shapes' aggregates appearing over the computer screen, randomly and rapidly changing their position in space, while manipulating them as required. As the software users' skills increase, their level and speed also increase. The software helps to explain the structure of the shapes' aggregate and the connection between real shapes and their mental image by giving immediate feedback (24).
Computer-generated models or simulations are increasingly finding their way into areas such as building design and safety, air-flight training and controlling, medical training and surgery, transport systems, and ergonomics, as well as tourism and education. Under the label of 'entertainment,' video arcades and home computers now offer up a range of electronically generated simulations of activities such as auto racing, golf, football, skiing, boxing, and basketball (28).

Table 2 exemplifies the connection between the activities performed while training with Tetris software and the ability to analyze motor skills (see Table 2).

Table 2: An example of the connection between the activities performed while training with Tetris software and the ability to analyze motor skills

Training with Tetris software	Design	Analyzing passing the handball
The shapes' aggregate appears at the upper part of the game board.	The designer holds the design tool.	The pupils/players stay on the court.
Predicting the direction required for planning the next step in the game.	The designer checks and chooses the appropriate position of the design tool and its distance from the sheet of paper.	The pupils/players check and choose the distance of their body from the other participants so that the ball can be easily caught by one of their team-mates.

Training with Tetris software	Design	Analyzing passing the handball
Adjusting the shapes' aggregate to the appropriate direction.	The designer adjusts the design tool to the appropriate direction relating to the starting point of designing.	The pupils/players adjust the position of body by holding the ball for passing to one of the other players.
Navigating the shapes' aggregate down and then to the right or to the left side.	The designer navigates the design tool down and then to the right or to the left side.	The pupils/players pass the ball from one hand to the other while dribbling it from one side to the other side of the court. Sometimes they have to jump to pass the ball.

The data presented in table 2 show a parallelism between the training with Tetris Software and the stages of designing and those of passing the handball. Such a parallelism also exists with additional motor skills such as swimming, football, tennis, etc.

Virtual Reality and Motivation

The use of virtual reality enhances the motivation of its users, thanks to the possibility to make objects appear, disappear and transform. Zaretsky (29) indicated that many participants in her research, including students in colleges and pupils in schools, are more active and dynamic during the computerized activity, especially if the activity concerns creating simulations. The duration of concentration also increases.
The students learn and then teach the pupils how to observe the body movements, interpret, imagine and simulate virtually and in the real world, using knowledge research, deliver more knowledge of delights of life.
Glanville (30) suggested that "it is easy to do the well made and useful part of the equation, but that what is difficult is the 'delightful' and that this requires the designer to do more than is necessary, to make something better than what is there. It is the more than necessary that is the necessary bit – it is what brings the delight".

3. RESEARCH PRESENTATION

The study design focused on a qualitative research using a post-test open ended questionnaire for getting the participants' opinions, and comparing the pre service teachers' performance of virtual simulation design before and after the training with the Tetris software. The participants in the research, thirty first-year physical education pre service teachers, noted their achievements using Tetris software, and responded to an open ended questionnaire stating their opinions regarding the connection between training with Tetris software skills and designing virtual simulations for physical education lesson planning and teaching. The research lasted four months and included four stages:

1. Learning to design computer presentations;
2. Training with Tetris software and its analysis;
3. Designing virtual simulations in teaching units for their lessons;
4. Writing their analysis relating practice to theory.

The research questions are:

What is the connection between practicing with Tetris software skills, design and physical activity?
How can training with Tetris software skills impact on design and physical education lesson planning, through creating virtual simulations?

Media

The Computer software "Tetris Game" was used to examine its connection with physical skills. The players aim at filling three dimensional shapes' aggregates into rows and a large three dimensional cube with small shapes' aggregates. During the use of the Tetris task, block-shaped pieces appear at the top of the screen and fall down, while players manipulate them, so that they fit into point-scoring rows. In order to attain a high score, the users need to act precisely and rapidly. The users have to complete the blank locations on the game board according to an induced rule he had inferred and fit the appropriate shapes' aggregate in the blank locations.

The Tetris Software is characterized by the following:

1. Each shapes' aggregate appears at the upper part of the game board and is going down in a constant speed.
2. The degrees of difficulty are determined by the speed in which the shapes' aggregate moves down.
3. At any time when the line or the surface in the three dimensional Tetris game is filled, it is erased and the participant attains points.
4. The keys for training with the "Tetris" software are the same: The user can move the shapes' aggregate to the right or to the left side, or to take it down by using the arrow-keys. The shapes' aggregate can be rotated to fit the empty space to be filled by the use of the space bar, by 90^0 to the right or to the left side.

The use of "Tetris" Software trains Spatial Orientation and Visualization, motor skills, eye-hand coordination and time orientation.

4. FINDINGS

The pre service teachers' gains in points in Tetris software show a gradual increase of points, practicing with the software. Observing all the pre service teachers included in the research group, practicing with Tetris software revealed their progress and interest. In order to illustrate it, Table 3 presents the functioning of 6 pre service teachers that participated in this group (see Table 3).

Table 3: Examples of points gained by a representative part of the participants while training the Tetris Software

Participant	Participant 1		Participant 2		Participant 3		Participant 4		Participant 5		Participant 6	
Levels and trials	Level	Trial	Level	Trial	Level	Trial	Level	Trial	Level	Trial	Level	Trial
	Level 2	95 110 425 440 510 1020 1715 1955 1970 3210	Level 2 Level 1	1661 2820 3275 3531 4236	Level 1 Level 3	1382 1517 3750 4406	Level 1	365 475 1450 2356	Level 2	91 216 280 661 1236 1565 1680 2255 2301 2417	Level 1 Level 2	3835 3251

Gains acquired by pre service teachers.

The Contribution of Tetris Software to Physical Skills According to the Answers Given through the Open Ended Questionnaire

The pre service teachers filled the open ended questionnaire before and after practicing with Tetris Software.

Before training with the Tetris Software the connection between this software and physical skills was not clear to the pre service teachers.

But after the training:

A comparison of the pre service teachers' gains in the Tetris software with their answers to the open ended questionnaire indicated that as the use of the Tetris software as well as the gains increased, the pre service teachers became aware of the connection between manipulating virtual reality and physical activities. Consequently, the pre service teachers gradually improved their PowerPoint presentations. They planned the virtual movements over the computer screen, for example: running, swimming, jumping, etc.

Table 4: Samples of answers regarding the impact of Tetris Software on Design and Physical Skills

Skill	The Answers	Design
Planning	Predicting and planning the next movement/position in space that applies the given situation.	Predicting and planning the next line or shape of the design that applies the former line(s) or shape(s).
Thinking	Thinking precisely and rapidly, Developing spatial and motion thinking, Improvising movements in rapidly changing environment, Fitting the pace of action accordingly, Responding rapidly.	Developing the spatial thinking.
Orientation in Space	Orienting in narrow spaces, Controlling the directions in space in different environments.	Orienting in narrow and wide spaces,
Motor	Developing fine motor.	Developing fine motor.
Body Image	Increasing body balance.	Increasing hands balance.
Agility	Developing agility while performing motor activities.	
Concentration and Persistence	Improving concentration and persisting on the task until succeeding it.	Improving concentration and persisting on the task until succeeding it.

The pre service teachers answered for example:
"The use of Tetris software can improve quick response while predicting the next line, shape or step"; "Training with Tetris software develops the cognitive ability by planning movements, setting goals, thinking rapidly, persisting on the task until succeeding it. All these skills lead to the ability to correctly enact the body in real-time situations".

The pre service teachers stressed the impact of Tetris Software on the design of sportive activities by sequentially such as gymnastics and specifically ground gymnastics, basketball, tennis, shooting, light athletics, competitive tournaments, ball games, collective games, activities that require alertness and using adequate strategies. Some of the pre service teachers included in this category all the sport branches that lead to win. See for instance the citations as: "The Tetris software affects each game that requires thinking, for example, we can see the next step of attack in basketball game"; "The Tetris software affects Challenging activities such as basketball game which simultaneously enacts **thinking** and **motor** acts"; "The Tetris software affects planning strategies for the long term, while performing a relay race task, etc.".
The similar challenge of gaining points characterizes gaming Tetris Software, Sport games and also in competitive tournament, while wishing to win. Tetris game (software) as well as basketball, marksmanship, etc. improve eye-hand coordination. The answers given about the similarity between the Tetris software and physical skills were such as "Both kinds of activities enable the body/fingers presenting in different positions or directions in space. They also enable planning the movement in advance".

Simultaneously, the pre service teachers improved their level of using computers by training them to gradually use and create digital simulations of movements in space, when their self-image as computer users was improved. Consequently, the pre service teachers' ability to build virtual reality by using the computers improved their planning and the exercises they made for their physical education practical work.

Afterwards the pre service teachers used their presentations with pupils and reported a progress in performing physical activities, especially jumping, gymnastics and specifically ground gymnastics, shooting and movement games.
In this context, the design skill comes to fruition while performing activities such as designing the path before animating the movements of figures passing through the path.

5. DISCUSSION

The questions raised in this research are: what is the connection between practicing with Tetris software skills, design and physical activity, and how can training with Tetris software skills impact on design and physical education lesson planning, through creating virtual simulations?

Comparing the implications of Objectivism to those of Constructivism reveals the significance of virtual reality to education. According to the constructivist theory, the Immersive Virtual Reality enables first-person experiences by removing the interface that acts as a boundary between the participant and the computer. This is the only way, in which each person visually constructs his/her knowledge of the world, experiencing in the real world, as portrayed by the Computer, without the need for symbolic descriptions of the experience (31). In this context, we should emphasize the role of the computer as a mediator of the movement design.

Virtual reality environment is unique in its dynamic representation. It adds an animation to the design product.

Succeeding to create simulations of the real world enhances the motivation and delight of the participants to practice their studying. Consequently, the participants added a lot of simulations fitting the physical reality.

The research exemplifies the effects of the manipulation of shapes' aggregate rapidly moving on the computer screen. Besides the challenge of the computerized activities, it helps to build physical competence.

Some methods focus on manipulations allow and even encourage students to choose their own representation(s) material, can also be used to assess whether students understand the idea or just have learned to use material in a rote manner. Certain virtual manipulations encourage easy alterations of scale and arrangement, thus they go beyond what can be done with physical manipulations and demand increasingly complex and precise specifications. The Computer Manipulations guide students to reflect on their actions and alter them by predicting and explaining (32). The pre service teachers succeeded to apply the Physical Education theory in their practical work through the PowerPoint presentations, initiating from their need to understand the meaning of the movements and their design, the relationships between them and how to perform them successfully.

The Uniqueness of the Method

The uniqueness of this method focuses on the object(s) design and manipulation over the computer screen by the learner himself as appear in many software games (33). Generally, all or most computer games train spatial orientation and visualization, as the player has to orient himself/herself within a rapidly changing environment. Players of the computer game Tetris Software may choose to preview each upcoming shape in order to plan the next step in playing the game, manipulating the fast changing environment over the computer screen. The same skill is needed for designing and performing physical movements. (34).

Success in the game that is "gaining the points" has its motivating effect on the participants and thus enhances the effect of the training.

The contribution of virtual simulations to design and physical activities is thus focusing on the important findings as following:

- Allow to visualize complex dynamic processes (17)
- Improve three dimensional visualization and spatial intelligence.
- Develop the ability to recognize three dimensional shapes (35)
- Assist in decoding the problems and improve the performance.

6. SUMMARY AND CONCLUSIONS

The present study indicated that the use of the computer enhanced the thirty pre service teachers' awareness of the connection between the design and manipulation of virtual objects through the performance of virtual and physical activities. Moreover, the pre service teachers' creation of digital simulations, especially while performing complex ones, was improved. According to the pre service teachers' report about improving their pupils' physical skills, it seems that the design and virtual simulations serve as a mediator for developing physical skills such as running, gymnastics and specifically ground gymnastics, etc. During the virtual training process, which facilitated the virtual mode, the pre service teachers learned how to improve their planning physical movements in order to perform them successfully and fluently by sequentially. These improvements were also used to design their teaching programs for their future pupils.

7. REFERENCES

[1] D.D. Diaz,V.K. Sims, "Augmenting Virtual Environments: the Influence of Spatial Ability on Learning from Integrated Displays", **High Ability Studies**, Vol. 14, No. 2, pp. 191- 212, 2003.

[2] J. Lloyd, G.A. Riley, T.E. Powell, "The Role of Virtual Reality Technology in the Assessment and Training of Inexperienced Powered Wheelchair Users", **Disability & Rehabilitation**, Vol. 24, No. 11/12, pp. 599-606, 2002.

[3] A. Harrison, G. Derwent, A. Enticknap, F.D. Rose, E.A. Attree, ""Errorless Learning of Novel Routes through a Virtual Town in People with Acquired Brain Injury". **Neuropsychological Rehabilitation**, Vol. 19, No. 1, pp. 98 -109, January, 2009.

[4] D. Passig, "Sport, Athletics and Virtual Reality", **Passig E-zine # 27** Unsubscribe, Future Law Enforcement Technologies, 2004. http://www.passig.com.

[5] D. Passig & S. Eden, "Enhancing the Induction Skill of Deaf and Hard-of-Hearing Children with Virtual Reality Technology", **Journal of Deaf Studies and Deaf Education,** Vol. 5, No. 3, 2000, pp. 277-285, Oxford University Press.

[6] W.D.Winn, "Learning in Virtual Environments: A Theoretical Framework and Considerations for Design", **Educational Media International**, Vol. 36, No. 4, 2000, pp. 271-279.

[7] E. Zaretsky & E. Shoval, "Integrating Movement/ Body Movement and Computer", **Curriculum in physical Education for Young Children**, Jerusalem: The Ministry of Education and Culture, The Department of preschool education. (In Press) (In Hebrew).

[8] Y. Yair, R. Mintz, & S. Litvak, "3D Virtual Reality in Science Education: An Implication for Astronomy Teaching", **Journal of Computers in Mathematics and Science Education,** Vol. 20, No. 3, 2001, pp. 293-301.

[9] N. Ayache, **Medical Computer Vision, Virtual Reality and Robotics**, INRIA — EPIDAURE Project, BP93-06902, Sophia-Antipolis, 1999.

[10] R.M. Satava & S.B. Jones, "Current and future Applications of Virtual Reality for Medicine", **Proceedings of the IEEE**, Vol. 86, No. 3, 1998, pp. 484-489.

[11] R. Zaitchuk. & R.M. Satava, Medical Applications in Virtual Reality. **Communications of the ACM,** Vol. 40, No. 9, September, 1997, pp. 63 – 64.

[12] R. Szeliski, "Video Mosaics for Virtual Environments", **Computer Graphics and Applications, IEEE**, Vol. 16, No. 2, March 1996, pp. 22-30.

[13] D.G. Walshe, E. J. Lewis, S. I. Kim, K. O'Sullivan & B. K. Wiederhold, "Exploring the Use of Computer Games and Virtual Reality in Exposure Therapy for Fear of Driving Following a Motor Vehicle Accident", **CyberPsychology & Behavior**, Vol. 6, No. 3, June, 2003, pp. 329-334.

[14] T.B. Sheridan, **Telerobotics, Automation, and Human Supervisory Control**, MIT Press, Cambridge, Mass, 1992.

[15] C.C. Feng & H. He, "Design and Realization of Courseware for Teaching Glide Shot Put with Application of Virtual Reality Technology", **Acta Metallurgica Sinica**, Vol. 41, No**.** 5, 2007, pp. 35-70.

[16] H. Rheingold, **Virtual reality**, New York: Touchstone, 1991.

[17] H. S. Muscott, & T. Gifford, "Virtual Reality Applications for Teaching Social Skills to Students with Emotional and Behavioral Disorders", **1994 VR Conference Proceedings,** 1994**.**

[18] P. Horwitz, "Designing Computer Models that Teach", in **Computer Modeling and Simulation in Pre-College Science Education**, 1999, pp. 179 - 196, Nancy Roberts and Wallace Feurzeig, eds., Springer Verlag.

[19] E, Bisson, B. Contant, H, Sveistrup & Y. Lajoie, "Functional Balance and Dual-Task Reaction Times in Older Adults are Improved by Virtual Reality and Biofeedback Training", **Cyberpsychology & Behavior**, Vol. 10, 2007, pp. 16-23.

[20] D. H. Clements, & S. McMillen, "Rethinking Concrete Manipulatives", **Teaching Children Mathematics,** Vol. 2, No. 5, 1996, pp. 270-279.

[21] M. Roza-Zada, guided by E. Zaretsky, **Training Computer Game "Tetris" and its Effect on Spatial Skills and Mathematics in Adolescents with Attention Deficit Hyperactivity Disorder (ADHD),** Thesis Submitted for the M.A. Degree at The Hebrew University of Jerusalem (In Hebrew), 1995.

[22] E. Zaretsky & V. Bar, "Intelligent Virtual Reality and its Impact on Spatial Skills and Academic Achievements", **The 10th International Conference on Information Systems Analysis and Synthesis: ISAS 2004 and International Conference on Cybernetics and Information Technologies, Systems and Applications: CITSA 2004.**

[23] A. Pazhitnov, **Tetris: There is no Simple Strategy**, Nintendo Entertainment System, 1985.

[24] C. Kieran, & H. Joel, "Its tough When You Have to Make the Triangles Angles: Insight Computer Based Geometry Environment", **Journal of Mathematical Behavior**, Vol. 9 (October), 1990, pp.99-127.

[25] V. Pantelidis, "Reasons to Use VR in Education", **VR in the Schools***,* Vol. 1, 1995, pp. 9.

[26] M.S. Darrow, "Increasing Research and Development of VR in Education and Special Education". **VR in the School**, Vol. 1 No. 3, 1995, pp. 5-8.

[27] K.M. Osberg, "Virtual Reality and Education: Where Imagination and Experience Meet", **VR in the Schools***,* Vol. 1, No. 2, 1995, pp. 1-3.

[28] D. Hemphill, "Cybersport", **Journal of the Philosophy of Sport**, Vol. 32, No. 2, 2005, pp. 195-207.

[29] E. Zaretsky, **Publications of the College in the Country and all over the World,** Giv'at Washington College of Education (Hebrew), 2003.

[30] A. Barnes, "Firmitas, Utilitas, Venustas", **Geo/Graphic**, Blogspot, UK: London, Jan. 29, 2010.

[31] W. Winn, **A Conceptual Basis for Educational Applications of Virtual Reality,** HIT Lab Technical Report R-93-9. Seattle: Human Interface Technologies Laboratory, 1993.

[32] D. H., Clements, & S. McMillen, "Rethinking 'Concrete' Manipulatives", In D. L. Chambers (Ed.), **Putting Research into Practice in the Elementary Grades** (pp. 252-263), Reston, VA: National Council of Teachers of Mathematics, 2002.

[33] P.A. McClurg, & C. Chaille, "Computer Games: Environments for Developing Spatial Cognition?", **Journal of Educational Computing Research**, Vol. 3, 1987, pp. 95-111.

[34] E. Zaretsky, "Telecommunication in Special Education Pupils for Training their Basic Skills", **The 9th International Conference on Computer, Communication and Control Technologies (CCCT '03),** 2003**.**

[35] D.J. Ainge, "Upper Primary Students Constructing and Exploring Three Dimensional Shapes: A Comparison of Virtual Reality with Card Nets", **Journal of Educational Computing Research,** Vol. 14 No. 4, 1996, pp. 345-369.