Teaching Mathematics to Children with Mental Retardation using Computer Games

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Abstract

This experimental study investigated whether computer games help in teaching Mathematics to children with mental retardation and whether computer games help equally both boys and girls. The quasi-experimental two-group pre & post test design was used for the study. The results obtained through ANCOVA were in favor of Computer games for both boys and girls. However, boys seemed to benefit more from computer-games.

Keywords: Mathematics-teaching, Mental Retardation, Computer-Games

Introduction

As a significant step towards the realization of the universal right to education in India, the Right of Children to Free and Compulsory Education Act, 2009 is in force since April, 2010. The education rights of children with disabilities were addressed in the provision to Section 3 of Right to Education Act, 2009 (RTEA). However, the First Country Report of India (draft for consultation) to be submitted in pursuance of Article 35 of the UNCRPD states that “a range of educational options have been utilized by the country. However these are not available to all persons with disabilities in all parts of the country.” Particularly, teaching Mathematics-concepts to children with mental retardation pose a great challenge to special teachers in all parts of India and it causes lack of Mathematics skills in these children to a great extent. This hampers their education and rehabilitation in many ways. The time is very ripe to think and implement innovative practices for teaching Mathematics to these children.

UNESCO (2011) says that “How Information and Communication Technology (ICT) can be used in the most effective ways for education of people with disabilities is currently high on the political agendas of all countries, particularly those who have ratified the United Nations Convention on the Rights of Person with Disabilities (CRPD, 2006)”. The key statement within the CRPD (2006) relevant for ICT and people with disabilities is within Article 9: To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and other facilities and services open or provided to the public, both in urban and rural areas.

Mental retardation is the state of incomplete mental development of such a kind and degree that the individual is incapable of adapting himself to the normal environment of his
fellowmen in such a way as to maintain existence independently of supervision, control and external support and result is the incomplete and insufficient development of mental capacities. According to statistics made available by the Centers for Disease Control and Prevention in the 1990s, mental retardation occurs in nearly 6 percent of the general population. Figure I give the details of mentally disabled population in India according to the census of India 2001.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td>2,263,821</td>
<td>1,593,777</td>
<td>670,044</td>
</tr>
<tr>
<td>Males</td>
<td>1,354,653</td>
<td>949,373</td>
<td>405,280</td>
</tr>
<tr>
<td>Females</td>
<td>909,168</td>
<td>644,404</td>
<td>264,764</td>
</tr>
</tbody>
</table>

(According to the Census of India 2001)

Figure I: Mentally Disabled Population in India

Further, According to 2001 Census:

- Of the total population, 2.13% are persons with disabilities, of which male population is 57.5 whereas their female counterpart comprises of the balance 42.5%.
- 75% of the population of persons with disabilities lives in rural areas.
- Uttar Pradesh has highest population of persons with disabilities. The disabled population of Uttar Pradesh is 3.4 millions.
- Disability in seeing is highest in India which is 48.55%. The next highest is Disability in Movement with 27.87%. Disability in Mental and Speech population is nearly 18% and the least disabled population is Disability in Hearing which is 5.76%.
- Literacy of population of persons with disabilities is 49% which is lower when compared to the general population.

Background of the Study

The use of multimedia in education and training has significantly changed educators’ perception of learning processes. Results from a number of research studies indicate that appropriate multimedia instruction enhances students’ learning performance in science, mathematics, and literacy (Gee, 2003). Studies indicate that computer-assisted instruction (CAI) programs have important factors that can motivate, challenge, increase curiosity and control, and promote fantasy in children (Tzeng, 1999). Despite the fact that computer and video games have the same multimedia capability as CAI programs, their potential learning impact is often discounted by parents and educators. Recently, computer-based video games’ presence and popularity have been ever-growing, and game developers and researchers have started to investigate video games’ impact on students’ cognitive learning (Begg, Dewhurst, & Macleod, 2005; Squire, 2003; Vaupel, 2002).

Pillay commenced a study investigating the influence of recreational computer games on children’s subsequent performance on instructional tasks (Pillay, 2002). While game-playing is
regarded somewhat negative in educational settings, particularly for young children, re-
scrutinization of its influence in a teaching and learning context is crucial. The study by Chuang
& Chen (2009) investigated whether computer-based video games facilitate children’s cognitive
learning achievement as compared to traditional CAI programs. They reported that playing
computer-based video games was determined to be more effective in facilitating third-graders’
average learning outcome than text-based computer-assisted instruction. Research results from
the Kaiser Family Foundation and the Children’s Digital Media Centers (Rideout, Vandewater,
& Wartella, 2003) found that children in the United States are growing up with media and are
spending hours a day watching television and videos, using computers, and playing video games.
According to the findings, today’s children are starting to be exposed to technologies and media
at a much younger age than previously thought. Therefore, educators’ investigations become
critical concerning the impact of technologies and media on children’s development and
learning.

Most previous research studies related to computer-based video games focused on the
discussions of psychological study and child behavior (Provenzo, 1991; Squire, 2003). In
psychological study, research results indicated that video games can promote hand-eye
coordination, visual scanning, auditory discrimination, and spatial skills (Johnson, Christie, &
Yawkey, 1999; Lisi & Wolford, 2002). For child behavior, evidence showed that violent video
games may raise children’s aggressive play and violent behaviors (Funk, 2001). The study by Li
et al (2012) aimed to explore the effects of applying game-based learning to webcam motion
sensor games for autistic students’ sensory integration training for autistic students. The findings
of the study revealed that: (1) the teacher and the participants possess positive attitude toward
applying webcam motion sensor games to sensory integration training; (2) Webcam motion
sensor games can enhance autistic students’ learning interest; and (3) applying the game-based
learning to webcam motion sensor games can improve the effect of autistic students’ muscle
training and endurance.

In addition to the many established benefits of computers in instructional technology,
there are several additional reasons that computer intervention programs are an appropriate
choice for mentally retarded populations (Silver & Oakes, 2001). As mentioned above, one of
the more common difficulties mentally retarded children face is sensory-overload: the inability to
filter out unneeded and irrelevant sensory input. Placing the child at a computer terminal and
having him focus on the screen can help to avoid that problem because only important and
necessary information needs to be displayed. Teachers must understand how software may
provide opportunities for the student with disabilities to control environments, to stimulate
imagination, to interact with others, and to use open-ended exploration to facilitate development
of higher order skills (Weber & Forgan, 2002; Weber, Forgan, Schoon, & Singler, 1999; Weber
& Schoon, 2001).

Technology as a teaching tool immediately, profoundly, and positively impacted the
education of individuals with mental retardation. The use of assistive technology devices for
individuals with mental retardation was shown by Wehmeyer (1998) to increase self-
determination, independence, and integration skill. In addition, assistive devices allowed for
“positive changes in inter- and intrapersonal relationships, sensory abilities and cognitive
capabilities, communication skills, motor performance, self-maintenance, leisure, and
productivity” (Parette, 1997, p. 268). There are a good number of researches in the field of
computer assisted instruction for normal children but there is a dearth of knowledge with respect
to CAI and mentally retarded children particularly in India. Hence, the present study was
conceptualized and carried out.
Statement of the Problem

A Study of Effectiveness of Computer Games in Teaching Mathematics to Children with Mental Retardation

Operational Definitions

Computer Games

As already stated, results from a number of research studies indicate that appropriate multimedia instruction enhances students’ learning performance in science, mathematics, and literacy. Studies indicate that computer-assisted instruction (CAI) programs have important factors that can motivate, challenge, increase curiosity and control, and promote fantasy in children. CAI consists of the use of computer to present the substantial amount of learning material to the student or in other words instruction is given to the students with the help of computer. Once the instructional materials are installed, the learners can learn individually at their own unique pace at the computer terminals.

In the present study, Computer Aided Instruction was used in the form of computer games only.

Children with Mental Retardation

In the 3rd edition of Diagnostic and Statistical Manual of Mental Disorders, mental retardation has been described as a condition characterized by significantly sub-average intellectual functioning, resulting in or associated with, deficits or impairments in adaptive behaviour. It occurs during the developmental period, i.e., before 18 years of age. Therefore, such a person finds it difficult to adapt to the learning situation.

In the present study, the mentally retarded children means those children having IQ less than 70 and who are showing skill deficits in three areas, namely, numbers, time, and money, out of 18 defined in Madras Developmental Programming System (MDPS) by Jayachandran & Vimla(1992).

Objectives of the Study

The major objectives of the present study were:

I. To study the effect of Computer games on teaching of Mathematics concepts among children with mental retardation.

II. To study the effect of gender on acquisition of Mathematics-concepts through Computer-Games among Children with Mental Retardation.

As there are three skills associated to Mathematics concepts in MDPS, namely, number, time, and money, therefore the major objective was divided into following minor objectives:

1. To assess the main effect of group (control vs experimental) on remediation of Number skills deficit among children with mental retardation.

2. To assess the main effect of gender (boys vs girls) on remediation of Number skills deficit among children with mental retardation.
3. To study the interaction effect between group and gender on remediation of Number skills deficit among children with mental retardation.
4. To assess the main effect of group (control vs experimental) on remediation of time related skills deficit among children with mental retardation.
5. To assess the main effect of gender (boys vs girls) on remediation of time related skills deficit among children with mental retardation.
6. To study the interaction effect between group and gender on remediation of time related skills deficit among children with mental retardation.
7. To assess the main effect of group (control vs experimental) on remediation of money related skills deficit among children with mental retardation.
8. To assess the main effect of gender (boys vs girls) on remediation of money related skills deficit among children with mental retardation.
9. To study the interaction effect between group and gender on remediation of money related skills deficit among children with mental retardation.

Hypotheses

As the present study was self-exploratory in nature, hence the following null hypotheses were formulated:

$H_1$: Significant main effect of group on remediation of number skills deficits does not exist among children with mental retardation.
$H_2$: Main effect of gender on remediation of number skills deficit is not significant among children with mental retardation.
$H_3$: Significant interaction between group and gender does not exist with respect to remediation of number skills deficits among children with mental retardation.
$H_4$: Significant main effect of group on remediation of time-related skills deficits does not exist among children with mental retardation.
$H_5$: Main effect of gender on remediation of time-related skills deficit is not significant among children with mental retardation.
$H_6$: Significant interaction between group and gender does not exist with respect to remediation of time-related skill deficits among children with mental retardation.
$H_7$: Significant main effect of group on remediation of money-related skills deficits does not exist among children with mental retardation.
$H_8$: Main effect of gender on remediation of money-related skills deficit is not significant among children with mental retardation.
$H_9$: Significant interaction between group and gender does not exist with respect to remediation of money-related skill deficits among children with mental retardation.

Method

Materials used to conduct the research

A variety of materials were gathered by the researchers as hardware, software and a standardized tool for data collection. Hardware was used to conduct the treatment; software was
used for testing and treatment purpose and various computer-games for remediation of Mathematics-concepts related skill deficits of mentally retarded students were used in treatment. Standardized tool, Madras Developmental Programming System (MDPS, 1992), developed by Prof. P. Jayachandran & Prof. V. Vimla, was used for the data collection and to conduct the pre and post tests.

Sample

The population of mentally retarded children was selected from Bareilly city of Uttar Pradesh. Children with a diagnosis of MR, as defined by the DSM-IV (American Psychiatric Association, 2000), who were in the chronological age range of 6 to 16 were the participant for this investigation. Only the students with mild and moderate mental retardation were selected. The sample was not drawn randomly but all 18 children located by researchers as having mild/moderate mental retardation were selected for the study.

Research design

Experimental research design was used because only this type of design was fulfilling the purpose of coming up to conclusive results from the study. But in social-sciences, true experimental researches are almost impossible. Thus quasi-experimental two-group pre & post test design was used for the study. The sample for the study, after formation of the groups, was as under:

<table>
<thead>
<tr>
<th>Table I Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Remedial Treatment (Experimental group)</td>
</tr>
<tr>
<td>Boys</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

Procedure

Two groups were formed for the study. The first group, termed as the control group, was taught with the conventional method used for teaching children with mental retardation. In it, children were taught by the researchers using individual teaching plans (ITP) and group teaching plans (GTP). The second group, termed as the experimental group, was taught with the help of simulation games on computers. These games, related to selected Mathematics concepts, were downloaded from internet. A scrutiny was done to ensure these games consisted all the required sub-concepts related to selected concepts, i.e., number, time and money as included in MDPS. Variables such as duration of study, place of study, instructor and learning-content were controlled in the study.

Statistical Treatment

In order to compare the effectiveness of Computer-games and Conventional Method, statistical analysis was done. In the present research, perfect dichotomization and randomization of the sample was not possible. Hence, the appropriate statistical method- ANCOVA- was used to nullify the effect of nonequivalence of groups (Winer, Brown & Michels, 1991). Pre-test and
Post-test scores were analyzed to see the effect on skill deficits level of the two groups, scores on the pre-test were taken as co-variates.

**Results and Discussion**

Results obtained are being presented skill-vise. As stated earlier, three skills related to Mathematics-concepts from MDPS were selected for the study.

**Results Related with Number Skills**

The first objective of the study was to assess the main effect of group (control vs experimental) on remediation of Number skills deficit among children with mental retardation. The second objective of the study was related to assessment of the main effect of gender (boys vs girls) on remediation of Number skills deficit among children with mental retardation. The third objective aimed at studying the interaction effect between group and gender on remediation of Number skills deficit among children with mental retardation. To realize these objectives, analysis of covariance (ANCOVA) was performed for number-post scores keeping number-pre scores as covariate. The results obtained have been shown in the Table-II.

**Table II ANCOVA for Number Skills: Tests of Between-Subjects Effects**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>number_pre</td>
<td>113.748</td>
<td>1</td>
<td>113.748</td>
<td>97.700**</td>
</tr>
<tr>
<td>group</td>
<td>32.027</td>
<td>1</td>
<td>32.027</td>
<td>27.508**</td>
</tr>
<tr>
<td>gender</td>
<td>.274</td>
<td>1</td>
<td>.274</td>
<td>.235(n.s.)</td>
</tr>
<tr>
<td>group * gender</td>
<td>6.342</td>
<td>1</td>
<td>6.342</td>
<td>5.447</td>
</tr>
<tr>
<td>Error</td>
<td>15.135</td>
<td>13</td>
<td>1.164</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2191.000</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 0.01 level, *Significant at 0.05 level, and n.s.: non-significant**

From Table II, it can be seen that main effect of group is highly significant (F=27.508, p<0.01). Further, the adjusted means for the two groups were obtained to clarify the direction of the difference among the two groups. These means have been shown in Table III.

**Table III Adjusted Number post means for groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.192</td>
<td>0.399</td>
</tr>
<tr>
<td>Experimental</td>
<td>12.105</td>
<td>0.367</td>
</tr>
</tbody>
</table>

A look at above table shows that the experimental group (mean=12.105) performed better then the control group (mean=9.192), i.e., the group taught through Computer games has shown...
greater improvement on number skills than in conventional group. This means that children from experimental group improved their number skills significantly higher than those from control group. It simply means that learning through computer games is superior to learning through conventional method for children with mental retardation with regard to learning of numbers and related concepts. Thus, first hypothesis $H_1$ that “Significant main effect of group on remediation of number skills deficits does not exist among children with mental retardation” is rejected. Learning number and related concepts through computer games is more beneficial as compared to conventional method of ITP & GTP. These results are in congruence with the observations made by Parette, 1997; Silver & Oakes, 2001; Weber & Forgan, 2002; Weber, Forgan, Schoon, & Singler, 1999; Weber & Schoon, 2001. There may be various reasons for this superiority of computer games over conventional method as with Computer games, the child may rehearse the same thing again and again without the wastage of any material in a drill and practice manner in an entertaining way. Graphics and animation, entertainment value, frequent and informative feedback and adequate number of opportunities for practice contribute to greater learning of number skills through computer games.

As shown in Table II, the main effect for gender was found insignificant ($F=0.235$, $p>0.05$). This insignificant value shows that boys and girls did not differ significantly in improvement of number skills. To further probe into the matter, adjusted means were calculated. These have been presented in Table IV.

Table IV Adjusted Number post means for gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>10.787</td>
<td>0.338</td>
</tr>
<tr>
<td>Girls</td>
<td>10.510</td>
<td>0.435</td>
</tr>
</tbody>
</table>

A perusal of Table IV shows that the means for both boys as well as girls were almost same. This proves that boys and girls fair equally with regard to improvement in number skills. Thus the second hypothesis $H_2$ that “Main effect of gender on remediation of number skills deficit is not significant among children with mental retardation” is accepted.

However, the $F$ value ($5.447$, $p<0.05$) for the interaction effect of group and gender on improvement of number skills was found to be significant. Significant $F$ value means that boys and girls do differ significantly in the improvement of number skills under the two teaching methods, Computer-games and conventional method. The matter was further clarified with the help of adjusted number post means. These have been shown in Table V.

Table V Adjusted Number post means for gender*group

<table>
<thead>
<tr>
<th>Group</th>
<th>gender</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>boys</td>
<td>8.716</td>
<td>0.441</td>
</tr>
<tr>
<td></td>
<td>girls</td>
<td>9.667</td>
<td>0.666</td>
</tr>
<tr>
<td>Experimental group</td>
<td>boys</td>
<td>12.858</td>
<td>0.511</td>
</tr>
<tr>
<td></td>
<td>girls</td>
<td>11.353</td>
<td>0.541</td>
</tr>
</tbody>
</table>
Table V reveals that mean-gain for boys, under the experimental method, was greater than that for girls. Thus, boys were more benefited from computer games as compared to girls with regard to improvement in number skills. Therefore, the third hypothesis $H_3$ that “Significant interaction between group and gender does not exist with respect to remediation of number skills deficits among children with mental retardation” is rejected. No study could be located to support or refute this finding. No reasons for this surprising superiority of boys over girls could be thought of. However, it was concluded that boys and girls do not benefit equally in improvement in number skills under the two teaching methods, computer games and conventional method.

**Results for Time-Related Skills**

The fourth objective of the study was to assess the main effect of group (control vs experimental) on remediation of time-related skills deficit among children with mental retardation. The fifth objective of the study was related to assessment of the main effect of gender (boys vs girls) on remediation of time-related skills deficit among children with mental retardation. The sixth objective aimed at studying the interaction effect between group and gender on remediation of time-related skills deficit among children with mental retardation. To realize these objectives, analysis of covariance (ANCOVA) was again performed for time-post scores keeping time-pre scores as covariate. Results obtained have been shown in the Table VI.

**Table VI ANCOVA for Time-related Skills: Tests of Between-Subjects Effects**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>time_pre</td>
<td>95.343</td>
<td>1</td>
<td>95.343</td>
<td>96.281**</td>
</tr>
<tr>
<td>group</td>
<td>26.036</td>
<td>1</td>
<td>26.036</td>
<td>26.292**</td>
</tr>
<tr>
<td>gender</td>
<td>.451</td>
<td>1</td>
<td>.451</td>
<td>.456(n.s.)</td>
</tr>
<tr>
<td>group * gender</td>
<td>.017</td>
<td>1</td>
<td>.017</td>
<td>.017(n.s.)</td>
</tr>
<tr>
<td>Error</td>
<td>12.873</td>
<td>13</td>
<td>.990</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1713.000</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 0.01 level, * Significant at 0.05 level, and n.s.: non-significant

From Table VI, it can be seen that main effect of group is highly significant ($F=26.292$, $p<0.01$). Further, the adjusted means for the two groups were obtained to clarify the direction of the difference among the two groups. These means have been shown in Table VII.

**Table VII Adjusted Time post means for groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>8.100</td>
<td>0.368</td>
</tr>
<tr>
<td>Experimental</td>
<td>10.759</td>
<td>0.342</td>
</tr>
</tbody>
</table>
A look at above table shows that the experimental group (mean=10.759) performed better than the control group (mean=8.100), i.e., the group taught through Computer games has shown greater improvement on time-related skills than in conventional group. This means that children from experimental group improved their time-related skills significantly higher than those from control group. It simply means that learning through computer games is superior to learning through conventional method for children with mental retardation with regard to learning of time and related concepts. Thus, fourth hypothesis \( H_4 \) that “Significant main effect of group on remediation of time-related skills deficits does not exist among children with mental retardation” is rejected. Learning time and related concepts through computer games is more beneficial as compared to conventional method of ITP & GTP. These results are again in congruence with the observations made by Parette, 1997; Silver & Oakes, 2001; Weber & Forgan, 2002; Weber, Forgan, Schoon, & Singler, 1999; Weber & Schoon, 2001. There may be various reasons for this superiority of Computer games over conventional method as with Computer games, the child may rehearse the same thing again and again without the wastage of any material in a drill and practice manner in an entertaining way. Graphics and animation, entertainment value, frequent and informative feedback and adequate number of opportunities for practice contribute to greater learning of time-related skills through computer games.

As shown in Table VI, the main effect for gender was found insignificant \( (F=0.456, \ p>0.05) \). This insignificant value shows that boys and girls did not differ significantly in improvement of time-related skills. To further probe into the matter, adjusted means were calculated. These have been presented in Table VIII.

**Table VIII Adjusted Time post means for gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>9.262</td>
<td>0.304</td>
</tr>
<tr>
<td>Girls</td>
<td>9.597</td>
<td>0.387</td>
</tr>
</tbody>
</table>

A perusal of Table VIII shows that the means for both boys and girls were almost same. This proves that boys and girls fair equally with regard to improvement in time-related skills. Thus the fifth hypothesis \( H_5 \) that “Main effect of gender on remediation of time-related skills deficit is not significant among children with mental retardation” is accepted.

Similarly, the \( F \) value \( (0.017, \ p>0.05) \) for the interaction effect of group and gender on improvement of time-related skills was also found to be insignificant. Insignificant \( F \) value means that boys and girls do not differ significantly in the improvement of time-related skills under the two teaching methods, Computer-games and conventional method. The matter was further clarified with the help of adjusted time-post means. These have been shown in Table IX.

**Table IX Adjusted Time post means for gender*group**

<table>
<thead>
<tr>
<th>Group</th>
<th>gender</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>boys</td>
<td>7.901</td>
<td>0.406</td>
</tr>
<tr>
<td></td>
<td>girls</td>
<td>8.300</td>
<td>0.611</td>
</tr>
<tr>
<td>Experimental group</td>
<td>boys</td>
<td>10.623</td>
<td>0.453</td>
</tr>
<tr>
<td></td>
<td>girls</td>
<td>10.895</td>
<td>0.502</td>
</tr>
</tbody>
</table>
Table IX reveals that mean-gain for boys, under the two methods, was almost similar to that for girls. Thus, both boys and girls benefitted equally from computer games with regard to improvement in time-related skills. Therefore, the sixth hypothesis $H_6$ that “Significant interaction between group and gender does not exist with respect to remediation of time-related skills deficits among children with mental retardation” is also accepted. No study could be located to support or refute this finding. Thus, it was concluded that boys and girls do benefit equally in improvement in time-related skills under the two teaching methods, computer games and conventional method.

**Results for Money-Related Skills**

The seventh objective of the study was to assess the main effect of group (control vs experimental) on remediation of money-related skills deficit among children with mental retardation. The eighth objective of the study was to assess the main effect of gender (boys vs girls) on remediation of money-related skills deficit among children with mental retardation. The ninth and last objective aimed at studying the interaction effect between group and gender on remediation of money-related skills deficit among children with mental retardation. To realize these objectives, analysis of covariance (ANCOVA) was again performed for money-post scores keeping money-pre scores as covariate. The results obtained have been presented in the Table X.

**Table X ANCOVA for Money-related Skills: Tests of Between-Subjects Effects**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money_pre</td>
<td>85.509</td>
<td>1</td>
<td>85.509</td>
<td>93.095*</td>
</tr>
<tr>
<td>group</td>
<td>21.199</td>
<td>1</td>
<td>21.199</td>
<td>23.079*</td>
</tr>
<tr>
<td>gender</td>
<td>5.387</td>
<td>1</td>
<td>5.387</td>
<td>5.865*</td>
</tr>
<tr>
<td>group * gender</td>
<td>5.654</td>
<td>1</td>
<td>5.654</td>
<td>6.156</td>
</tr>
<tr>
<td>Error</td>
<td>11.941</td>
<td>13</td>
<td>.919</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2171.000</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 0.01 level, *Significant at 0.05 level, and n.s.: non-significant**

From Table X, it is obvious that main effect of group is highly significant ($F=23.079$, $p<0.01$). Further, the adjusted means for the two groups were obtained to clarify the direction of the difference among the two groups. These means have been shown in Table XI.

**Table XI Adjusted Money post means for groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.454</td>
<td>0.353</td>
</tr>
<tr>
<td>Experimental</td>
<td>11.861</td>
<td>0.332</td>
</tr>
</tbody>
</table>
A perusal of above Table XI shows that the experimental group (mean=11.861) performed better than the control group (mean=9.454), i.e., the group taught through Computer games has shown greater improvement on money-related skills than in conventional group. This means that children from experimental group improved their money-related skills significantly higher than those from control group. It simply means that learning through computer games is superior to learning through conventional method for children with mental retardation with regard to learning of money and related concepts. Thus, seventh hypothesis H\textsubscript{7} that “Significant main effect of group on remediation of money-related skills deficits does not exist among children with mental retardation” is rejected. Learning money and related concepts through computer games is more beneficial as compared to conventional method of ITP & GTP. These results too are in congruence with the observations made by Parette, 1997; Silver & Oakes, 2001; Weber & Forgan, 2002; Weber, Forgan, Schoon, & Singler, 1999; Weber & Schoon, 2001. There may be various reasons for this superiority of Computer games over conventional method as with Computer games, the child may rehearse the same thing again and again without the wastage of any material in a drill and practice manner in an entertaining way. Graphics and animation, entertainment value, frequent and informative feedback and adequate number of opportunities for practice contribute to greater learning of money-related skills through computer games.

As shown in Table X, the main effect for gender was found to be significant (F=5.865, p<0.05). This significant value shows that boys and girls differ significantly in improvement of money-related skills. To further probe into the matter, adjusted means were calculated. These have been presented in Table XII.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>11.240</td>
<td>0.294</td>
</tr>
<tr>
<td>Girls</td>
<td>10.076</td>
<td>0.372</td>
</tr>
</tbody>
</table>

Table XII showed that the mean score for boys was higher than that for girls. This proves that boys excel over girls with regard to improvement in money-related skills. Thus, the eighth hypothesis H\textsubscript{8} that “Main effect of gender on remediation of money-related skills deficit is not significant among children with mental retardation” is rejected. No study could be located to support or refute this finding. The reason for this surprising superiority of boys over girls could be the small size of sample and/or cultural. Usually, in Indian culture, males are more entrusted with money related tasks as compared to females. However, it was concluded that boys and girls do not benefit equally in improvement in money-related skills irrespective of teaching methods.

Further, the F value (6.156, p<0.05) for the interaction effect of group and gender on improvement of money-related skills was also found to be significant. Significant F value means that boys and girls do differ significantly in the improvement of money-related skills under the two teaching methods, Computer-games and conventional method. The matter was further clarified with the help of adjusted money-post means. These have been shown in Table XIII.
A perusal of Table XIII reveals that mean-gain for boys, under the experimental method, was greater than that for girls. Thus, boys were more benefitted from computer games as compared to girls with regard to improvement in money-related skills. Therefore, the ninth hypothesis $H_9$ that “Significant interaction between group and gender does not exist with respect to remediation of money-related skills deficits among children with mental retardation” is rejected. No study could be located to support or refute this finding. The reason for this surprising superiority of boys over girls could also be the small size of sample and/or cultural. However, it was concluded that boys and girls do not benefit equally in improvement in money-related skills under the two teaching methods, computer games and conventional method.

**Conclusion**

The group taught with the help of computer games produced significantly greater remediation of Mathematics skills as compared to the group taught through conventional method of teaching. This means that computer games produce greater gain in Mathematics concepts among children with mental retardation. With regard to main effect of gender on acquisition of Mathematics-concepts, it was found that gender does not affect acquisition of Mathematics-concepts on two concepts. However, on one concept, a contradictory result was obtained. Similarly, it was found on two Mathematics concepts that boys benefit more from computer games as compared to girls. However, on one concept, no difference was found. Educationists and other scientists believe that early intervention gives children the best chance of developing their full potential. Here, the finding that Computer games improve the acquisition of Mathematics concepts than the conventional format of teaching may prove very useful.

**References**


