ICT based Education for Students with Special Educational Needs
Group Members:
- M. D. N. T. Perera
- T. G. I. S. D. Wijerathne
- D. P. M. M. Wijesooriya

Supervised By:
- Dr. Anuja Dharmaratne
- Dr. Ruvan Weerasinghe
According to the statistics…

✓ Estimated **3800** children enter grade 1 in each year have learning disabilities

✓ Prevalence of behavioral problems among children is reported as **27.2%**

✓ **1 in 93** children is affected by Autism in Sri Lanka

*Prof. Hemamali Perera, Prof. in Psychological Medicine, Faculty of Medicine, University of Colombo*
In Sri Lanka…

☑ Class room oriented education with a syllabus

☑ Limited specialized IT based applications

☑ No localized applications

☑ Less IT literacy for teachers in special education

☑ Less IT facilities in special educational centers
In Other Countries…

✓ More technological environments
  • Virtual classrooms
  • Robots

✓ High technological infrastructure

✓ Well veteran teachers with IT knowledge

✓ IT based educational environments
Motivation…

✓ Inattention of IT people towards special education

✓ Lack of IT infrastructure

✓ No involvement in developing localized applications

✓ No aware of potential usage of ICT in education
Scope of the project…

Special Educational Needs Students

Physically Disordered

Mentally Disordered

Intellectually Disabled

Autism

Downs Syndrome

ADHD
The Goal…
Upgrade the learning effectiveness of students with special educational needs using ICT in Sri Lankan Context

Objectives…
- Identify the group of students that can be supported through ICT
- Identify the effect of ICT on students’ ability of capturing concepts
- Develop ICT based activities as the learning aids
- If there would be positive results, distributing games among students
Related Work…

- ICT Based Education
- ICT Based Special Education
- Limiting Factors
- Game Based Learning
- Learning Environments
- Based on Disability

- Special Education in Sri Lanka
- Geographical Dispersion
- Technologies
- Special Software
- HCI
- Special Education Centers/schools

Literture Review
Some Literatures…

ICT based Special Education

“ICT can be used as a motivating factor rather than just using to communicate with the available knowledge”

By J.M.Ribeiro, A.Moreira and A.M.P.Almeida in 2009

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps students’ interest</td>
<td>Some motivational things may badly affect students</td>
</tr>
<tr>
<td>Facilitate the repetition of game</td>
<td></td>
</tr>
<tr>
<td>Guides to learning process indirectly</td>
<td></td>
</tr>
<tr>
<td>Adapt for individuals according to their level of disability</td>
<td></td>
</tr>
</tbody>
</table>
Human Computer Interaction

“It is necessary to design the user interfaces for maximum accessibility and usability”
- C.S. Lanyi et al in 2012

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve user engagement</td>
<td>Differ with the disability</td>
</tr>
<tr>
<td>Improve the independence of user</td>
<td></td>
</tr>
</tbody>
</table>

“Emphasis on using graphics, animations, interactivity, choice and auditory output to promote user engagement and provide alternatives to text”
Sri Lankan Context

“Improvement in tendency for inclusive education of teachers”

“Translating special education modules in English into Sinhala and Tamil by people who have domain knowledge”

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of the learning process</td>
<td>More classroom based activities</td>
</tr>
<tr>
<td>become high</td>
<td></td>
</tr>
</tbody>
</table>
Requirement Analysis…
Functional Requirements

✓ Developing activities and games specialized for slow learners

✓ Developing activities and games Sinhala

✓ Comparably slow according to the students

✓ Repetition of activities and games

✓ Auditory instructions avoiding text

✓ Inclusion of rewards in activities and games

✓ Measurement of progress
Architecture...

- Slow Learner
  - Primary
    - Colors
    - Numbers
    - Language
  - Intermediate
    - Colors
    - Numbers
    - Language
    - Shapes
  - Senior
    - Numbers
    - Language

- Three Primary Colors
  - Introduce Numbers
  - Introduce Letters
  - Primary Colors + Other colors
  - Number Concept
  - Words
  - Introduce Shapes
  - Calculations
  - Sentences
Design Considerations

According to Friedman & Bryen Recommendations for developing system for learning disabled students are,

- Use graphics, animations and icons
- Consistent and contrasting colors
- Use clear and unambiguous text
- Limiting the number of words
- Simple screen layout
Design Considerations cont…

✓ Large, clear navigation buttons
✓ Use clear audio
✓ Minimizing scrolling
✓ Descriptive hyperlinks
✓ Supporting text browsers
Design & Development

Games

Introductory sessions

Tests
Increase Difficulty with Levels

Level 1

Level 2

Level 3

Level 4

Level 5

Level 6

Level 7

Level 8

Level 9

Level 10
Implementation of Final Product

Development Tools

✓ Macromedia Flash 8 with Action Script 2.0
✓ Adobe Flash CS 4 with Action Script 3.0

Supportive Tools

✓ Adobe Photoshop CS 3
✓ Audacity 1.3
✓ Format Factory 2.10
To Run the Game

✓ Macromedia Flash Player 8 or above
✓ Any web browser with Shockwave Flash 10.3 plug in
✓ Mouse & Keyboard
✓ Speakers

User Manual

✓ In pdf format and included in the game
✓ In Sinhala language

License

✓ Under GNU General Public License (GPL) Version 3 copyleft license
Implement in Client Environment

Distribute game CDs among special education teachers in

✓ Special Education Units in Government Schools
✓ Private special education Centers
Distribution

- Through CDs
- Through Blog

- http://ictbasedspecialeducation.blogspot.com/
Evaluation

Three Rounds → Pre Test
     Practice
     Post Test

Considerations

- Increase the size of mouse pointer
- Practice mouse movements
Analysis

Based on

Number of Steps

Number of Mistakes

Dispersion of Sample

Time Taken
Analysis based on Number of Steps
<table>
<thead>
<tr>
<th>Complete all the steps in both pre test and post test</th>
<th>Percentages of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Color</td>
</tr>
<tr>
<td>Complete all the steps in both pre test and post test</td>
<td>48%</td>
</tr>
<tr>
<td>Higher number of steps in post test than pre test</td>
<td>45%</td>
</tr>
<tr>
<td>Complete same number of steps in both tests</td>
<td>-</td>
</tr>
<tr>
<td>Lesser number of steps in post test than pre test</td>
<td>7%</td>
</tr>
<tr>
<td>Zero steps in both tests</td>
<td>-</td>
</tr>
</tbody>
</table>
Analysis
based on
Time
- Different time
- Different number of steps
- Different number of mistakes

<table>
<thead>
<tr>
<th>Student</th>
<th>Time (Millisecond)</th>
<th>Number of Steps</th>
<th>Number of Mistakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std 1</td>
<td>903</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Std 2</td>
<td>730</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Std 3</td>
<td>1037</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Std 4</td>
<td>600</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Std 5</td>
<td>1128</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Std 6</td>
<td>300</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Std 7</td>
<td>385</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Std 8</td>
<td>968</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Average time (per step)**

\[
\text{Average time (per step)} = \frac{\text{Total Time}}{\text{Number of Steps}}
\]

**Average Number of Mistakes (per step)**

\[
\text{Average Number of Mistakes (per step)} = \frac{\text{Total Mistakes}}{\text{Number of Steps}}
\]
Color pre test vs post test

<table>
<thead>
<tr>
<th></th>
<th>Autism</th>
<th>Down Syndrome</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(6 students)</td>
<td>(16 students)</td>
<td>(5 students)</td>
</tr>
<tr>
<td>Less average time in post test than pre test</td>
<td>83%</td>
<td>94%</td>
<td>80%</td>
</tr>
<tr>
<td>Same average time in both tests</td>
<td>17%</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>More average time in post test than pre test</td>
<td>-</td>
<td>-</td>
<td>20%</td>
</tr>
</tbody>
</table>
Number Skills

Number pre test vs post test

<table>
<thead>
<tr>
<th>Condition</th>
<th>Autism (6 students)</th>
<th>Down Syndrome (16 students)</th>
<th>Other (5 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less average time in post test than pre test</td>
<td>83%</td>
<td>69%</td>
<td>60%</td>
</tr>
<tr>
<td>More average time in post test than pre test</td>
<td>17%</td>
<td>31%</td>
<td>40%</td>
</tr>
</tbody>
</table>
Language Skills

<table>
<thead>
<tr>
<th></th>
<th>Autism (6 students)</th>
<th>Down Syndrome (16 students)</th>
<th>Other (5 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less average time</td>
<td>100%</td>
<td>87%</td>
<td>75%</td>
</tr>
<tr>
<td>in post test than</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More average time</td>
<td>-</td>
<td>13%</td>
<td>25%</td>
</tr>
<tr>
<td>in post test than</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre test</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis
based on
Average Number of Mistakes
Color Skills

Color pre test vs post test

<table>
<thead>
<tr>
<th></th>
<th>Autism (6 students)</th>
<th>Down Syndrome (16 students)</th>
<th>Other (5 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less no. of mistakes in post test than pre test</td>
<td>17%</td>
<td>63%</td>
<td>40%</td>
</tr>
<tr>
<td>Same number of mistakes in both tests</td>
<td>33%</td>
<td>-</td>
<td>60%</td>
</tr>
<tr>
<td>Higher no. of mistakes in post test than pre test</td>
<td>50%</td>
<td>37%</td>
<td>-</td>
</tr>
</tbody>
</table>
## Number Skills

### Number pre test vs post test

<table>
<thead>
<tr>
<th></th>
<th>Autism (6 students)</th>
<th>Down Syndrome (16 students)</th>
<th>Other (5 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less no. of mistakes in post test than pre test</td>
<td>50%</td>
<td>81%</td>
<td>20%</td>
</tr>
<tr>
<td>No any mistakes in both tests</td>
<td>-</td>
<td>6%</td>
<td>40%</td>
</tr>
<tr>
<td>Same number of mistakes in both tests</td>
<td>33%</td>
<td>6%</td>
<td>20%</td>
</tr>
<tr>
<td>Higher no. of mistakes in post test than pre test</td>
<td>17%</td>
<td>6%</td>
<td>20%</td>
</tr>
</tbody>
</table>
## Language Skills

The bar chart displays the average number of mistakes for each student in both the language pre-test and post-test. The data is grouped by student ID (Std 1 to Std 27). The chart indicates the following:

### Language pre test vs post test

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Autism (6 students)</th>
<th>Down Syndrome (15 students)</th>
<th>Other (4 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less no. of mistakes in post test than pre test</td>
<td>50%</td>
<td>67%</td>
<td>50%</td>
</tr>
<tr>
<td>No any mistakes in both tests</td>
<td>-</td>
<td>13%</td>
<td>50%</td>
</tr>
<tr>
<td>Higher no. of mistakes in post test than pre test</td>
<td>50%</td>
<td>20%</td>
<td>-</td>
</tr>
</tbody>
</table>
Dispersion of the Sample
Color Pre Test

Average No. of Mistakes Per Step vs. Average Time

- Down Syndrome
- Autism
- Other

Average of Time
Average of Mistakes
Color Post Test

Average No. of Mistakes Per Step vs. Average Time

- **Down Syndrome**
- **Autism**
- **Other**

- **Average of Time**
- **Average of Mistakes**
Number Pre Test

![Graph showing average number of mistakes per step vs. average time, with data points for Down Syndrome, Autism, Other, Average of Time, and Average of Mistakes.](image-url)
Language Pre Test

Average No. of Mistakes Per Step vs. Average Time

- Down Syndrome
- Autism
- Other
- Average of Time
- Average of Mistakes
Language Post Test

Average No. of Mistakes Per Step vs. Average Time

Symbols:
- Diamond: Down Syndrome
- Cross: Autism
- Triangle: Other
- Red Line: Average of Time
- Blue Line: Average of Mistakes

Data points indicate the performance of different groups (Down Syndrome, Autism, Other) across varying time and mistake metrics.
Observations

• According to above statistics...

  - Time based improvement rates are higher than mistakes based rates
  
  - Time based improvement rates are higher for students with Down syndrome

  - Mistakes based improvement rates are higher for students with Autism
Conclusion

✓ Identified the effect of ICT on capturing concepts

✓ It is evident that…

ICT can leverage special education in Sri Lankan Context

✓ The deliverable…

- A bundle of games covering color, number & language
Limitations & Drawbacks

- Students may get bored
- Students may get used to high sensory input
- Lack of domain knowledge for content developers
- Resistance to adopt computer based learning
- Inability of students to operate a computer
Future Work

- Continuous training for better performance
- Hardware solutions as assistive technologies
- A way of identifying student’s performance level
- Digital art environments for improving artistic skills
- More games focusing different skills of using computers
Achievements...

- Computer Science Education: Innovation and Technology (CSEIT) 2012 – Singapore
- ICT for Emerging Regions (ICTer) 2012 – Sri Lanka