Developing a Numeracy Module for Students with Intellectual Disability in Higher Education

Adults Learning Mathematics
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What is Intellectual Disability?

- Intellectual Disability (ID) is defined as “limitations both in intellectual functioning and adaptive behaviour and originates before 18 years of age (AAIDD, 2010).

- Affects about 2–3% of the general population globally (De Vries et al., 2005).

- Can be caused by genetic and environmental factors (Maulik et al., 2011).
Issues faced by individuals with ID...

- A number of mental and physical disorders are often associated with ID (Maulik & Harbo, 2010).

- In addition, it is associated with a stigma and discrimination (Jeevanandam, 2009).

- It receives very little public attention, despite being considered the leading socio-economic health care problem in Western countries (Salvador-Carulla and Bertelli, 2008).
Issues faced by individuals with ID...

- Limited available resources and employment and choice making opportunities available to individuals with ID (WHO, 2007).

- Maulik et al. (2011) determine that the focus should be to integrate them in the larger community at all levels – education, workplace and social.

- Post-school pathways for this student population are typically complex and constrained (Davies & Beamish, 2009).
Trinity Centre for People with ID

• The Centre was established at TCD to promote the inclusion of people with ID and their families.

• Formally know as National Institute for Intellectual Disability (NIID) and established in 1998.

• The Centre works to ensure that the basic human rights of people are upheld associated with access to appropriate education and employment opportunities.

• Promotes lifelong learning through a 2 year taught course which is an inclusive education programme.
Arts, Science and Inclusive Applied Practice

• Formally known as the Certificate in Contemporary Living (CCL). It was reconceptualised and will run in its new form in September 2016.

• It will be run by the School of Education in Trinity College Dublin.

• It is a 2 year full-time course and will run from September to April each year.

• The has been accredited as a Level 5 Major Award.
Arts, Science and Inclusive Applied Practice

Students will study modules across six interdisciplinary themes:

- advanced learning theories and self-development;
- applied research theories and practice;
- applied science, technology and maths;
- business and marketing;
- advocacy, rights and culture;
- fine arts and languages
Mathematics Education of Students with ID

• The majority of students with disabilities do not reach grade level proficiency in mathematics (U.S. Department of Education, 2009).

• Students with ID may have limitations that interfere with the apprehension of certain mathematical concepts (de Oliveira Malaquias et al., 2013).
Mathematics Education of Students with ID

Typical features of students with ID that may interfere with the learning of concepts and skills in mathematics:

- Perceptual skills
- Thinking and Reasoning
- Memory
- Generalisation
- Attention
- Motivation

(de Oliveira Malaquias et al., 2013)
Mathematics Education of Students with ID

• Students with ID have succeeded in challenging areas of maths such as making decisions and creating their own strategies to solve word problems (Hord and Xin, 2015).

• Westwood (2011) determines that if students with ID are well motivated, and assisted in their educational needs through the use of efficient resources, they will succeed in their academic learning.
The Study

• The aim of this paper is to describe the design, development, piloting and evaluation of a numeracy module for students with ID in Higher Education.

• There is a limited amount of research available on designing curricula, and more specifically mathematics curricula, for students with ID (Göransson et al., 2016).

• A recent review of the literature by Hord and Bouck (2012) between 1999 and 2012 resulted in only seven articles on mathematics curricula for students with ID.
Overview of Application of Number Module

• Numeracy Module

  ‘the ability to access, use, interpret and communicate mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of situations in everyday life’ (OECD, 2009).

• Mandatory module – 5 ECTS

• One 2-hour class per week over one semester (11 weeks)
Aims of the Module

• To develop in students the ability to think critically about numeracy, express viewpoints, discuss logically and problem solve effectively.

• To equip students with the numeracy skills that they may require on a daily basis.

• To inspire students to develop their own numeracy learning skills which they may need to confidently.

• To encourage collaborative learning through project-based tasks incorporating numeracy skills and practical application.
Phase 1 – Design of the Module

What to do?
- Content
- Teaching
- Assessment
Content

• Schooling for students with ID has been criticised for not presenting the students with enough knowledge-related challenges, particularly in the area of mathematics (Göransson et al., 2016).

• Continued emphasis on procedural approach to mathematics education (Kyriacou and Issitt 2008).

• Textbooks focus on the repetitive practice of computational skills (Browder et al. 2012).
Content

• Crunching the Numbers: Budgeting, Shopping, Healthy Eating and Sport
• Types of Numbers - Introducing Odd, Even, Prime using Izak9
• Working with Numbers Visually and Actively using Izak9
• Favourite Numbers: The Life of Pi
• Data Handling
• Probability: What are the Chances?
• Shapes and Spaces
• Measurement
Content

• Incorporate technology (Burton et al., 2013)
• Understanding of skills could be promoted by linking mathematics to everyday contexts (Zambo, 2005).

What is the total amount of money spent?

What is the range of money spent on the different items?

What is the average amount of money spent on the different items?
Example:

Want to travel from Dublin to Glasgow from 1st June – 5th June. We need quote in Euro for:

- Parking at airport ([www.dublinairportcarparking.ie/](http://www.dublinairportcarparking.ie/))
- Flights ([www.flightscanner.ie](http://www.flightscanner.ie))
- 3* city centre hotel ([www.booking.com](http://www.booking.com))
- Spending money (£50 per day) ([www.xe.com/currencyconverter/](http://www.xe.com/currencyconverter/))

<table>
<thead>
<tr>
<th>Description</th>
<th>Total price in Euro</th>
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<tr>
<td>Flights</td>
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<tr>
<td>Hotel</td>
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<tr>
<td><strong>Total Budget</strong></td>
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Content

- Incorporate a blend of theoretical and functional math objectives (Browder & Cooper-Duffy, 2003)

My favourite number is Pi…… what is Pi?

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<thead>
<tr>
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<th>Circumference</th>
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<th>Circumference ÷ Diameter</th>
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<td>Object 1</td>
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<td>Object 4</td>
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Average =
Teaching Approaches

• Offer regular prompting with feedback (Browder et al. 2012)

• Provide opportunity for the student’s own initiative and participation (Göransson et al., 2016)

• Use concrete manipulatives (Jansen et al., 2013).
Example – Izak9 Cubes
Example – Izak9 Cubes
Teaching Approaches

• Encourage problem solving and reasoning

Example: Connect these nine dots with only four straight lines without lifting your pencil from the paper.
Example

What number is hidden under the car?

26 | 16 | 06 | 68 | 88 | 98 | 58
Teaching Approaches

• Incorporate educational games (de Oliveira Malaquias et al., 2013)

http://www.bbc.co.uk/skillswise/maths/games?page=2
Teaching Approaches

• Use visual representations (Kroesbergen & Van Luit, 2003).
What shapes are in each country's flag?
Assessment

- Participation 5%
- Budgeting Project 40%
- Favourite Number Presentation 15%
- End of term Exam 40%
Assessment

• Caution must be applied regarding the linguistic demands of mathematics assessments (Rhodes et al., 2015).

• The use of multiple choice in examinations is recommended (Zikl et al., 2015).

Example: The symbol $\pi$ represents which of the following numbers. Please circle the correct number (5 marks)

(a) 314  (b) 3.14  (c) 34.1  (d) 3
Phase 2 – Piloting of Module

• The module was piloted in the Hilary Term on the 2015/16 academic year with students completing the CCL

• 12 students – 3 males and 9 females

• Range in age from 21 – 39 years old

• Students with Mild to Moderate ID
Phase 3: Evaluation of Module
Evaluation

- Ramcharan and Grant (2001) recommend that disability research has an emphasis on establishing user views and experiences so that these can act as a driving force for change.

- Two Focus groups (8 students in total)
  - Analysed using thematic content analysis (Patton 2002)
  - 50 minutes in duration

- Three themes emerged from the transcript data:
  - Module content and design
  - Student feedback
  - Transfer of knowledge to facilitate independent
Focus Group Results

Module Content and Design

- The students stated that they learned topics such as adding, subtracting, diving, multiplying, budgeting, prime numbers, odd and even numbers, trigonometry, average, mean, and range.

- “The math module has been really good so far. We learned about evaluations, numbers, diving, multiplying. We did exams. We learned how to use our calculators on our phone.”
Focus Group Results

Student Feedback

• Overall the students had positive feedback about the math module.

• Many of the students talked about how the math module they took at TCD was very different from any other math course they had previously taken in school.

• “To me it was different because in school and place like that, they don’t really give you hard things, they don’t really give you things to push you to the limit. In college, they give you hard things and things that push you to the limit, which is good”
Focus Group Results

Transfer of Knowledge to Facilitate Independence

• The students spoke about how the knowledge they learned in their math module can be easily translated to real world settings, such as for employment, community living, and becoming more independent.

• “This will help me a lot because when I finish this course, I’ll be going into an IT course next and I’ll get a part-time job. So, that maths that I learn here I can bring it out in the open world and use it…”

• “Okay, this is important to me because if you’re getting a job you need to know how to count your own wages because if you can’t count your wages, your boss gives you the wrong wages, how do you know if the wage that you get is wrong or right.”
To Conclude....

• Very little is known about developing maths curricula for students with ID.

• Needs to be more research in this area for further development of teaching maths to students with ID.

• All students have a right to access curricula that foster the same type of knowledge, regardless of disability.

• Nothing new in what we have done, but it is new for students with ID.

• The module with some minor changes based on the piloting and evaluation will be rolled out with new cohort in September 2016
What number is hidden under the car?
Back to Problem Solving Example

Go raibh míle maith agaibh!
Aon Ceisteanna?