

Massive Open Online Courses (MOOCs) for Dyscalculic Children in an Inclusive Context

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Abstract: *Learning disability is a developmental issue which needs to be identified and tackled at a young age. Educating disabled children in an inclusive environment helps a lot in overcoming the difficulties faced by such children as they approach adulthood. The concept of Massive Open Online Courses (MOOCs), a recent phenomenon in distance education, and the possibility that it offers for educating students world-wide with learning disabilities in an inclusive setting by providing individualized education program to the student in need of special education through online means has been discussed in this paper. The paper addresses the problem of dyscalculia and the goal of the paper is to present ideas towards development of MOOCs for Dyscalculic children.*

Keywords: Learning Disabilities, Inclusive Education, Massive Open Online Courses

1. Introduction

Massive Open Online Courses (MOOCs), a recent phenomenon in distance education, refer to the concept of combining online video lectures, interleaved with practice quizzes, games, interactive applets, downloadable learning content like lecture notes, presentations, discussion forum etc. to form a virtual online course that is accessible to the world-wide internet user community. The word MOOC was coined by Bryan Alexander and Dave Cornier and was applied to a course conducted by George Siemens and Stephen Downes at the University of Manitoba, Canada in 2008.

A MOOC integrates the connectivity of social networking, the facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources. Perhaps most importantly, however, a MOOC builds on the active engagement of several hundred to several thousand 'students' who self-organize their participation according to learning goals, prior knowledge and skills, and common interests [5].

MOOCs are built on the characteristics of massiveness, openness, and a connectivist philosophy. MOOCs are gaining a lot of attraction worldwide, with leading universities and organizations competing to offer content to a world-wide audience. One of these initiatives is the edX initiative by Massachusetts Institute of Technology (MIT), Harvard University and Stanford University (<https://www.edx.org/>). There are also numerous other organizations like the Udacity (<https://www.udacity.com/>) and Coursera (<https://www.coursera.org/>) that offer MOOCs in various areas of interest in higher education. In a school level context, the Khan Academy could be thought of as a massive open online course, which can be accessed by students in schools to learn interesting concepts in Mathematics, Computer Science, Biology, Astronomy, Finance and Economics and numerous other interesting fields.

The activities which are usually conducted in a MOOC are as follows [7]:

- Online presentation of information, through lecture or video, or course materials
- Interactive exploration of the material, through wikis, discussion forums and other collaborative activities
- Assessment through machine graded multiple choice quizzes or tests and peer-reviewing / peer grading of written assignments in the form of essays or projects and other evaluation activities.

In this paper, we have tried to explore the concept of MOOC and the possibility that it offers for educating students with learning disabilities.

2. Learning Disabilities

Learning Disabilities, which are often considered as invisible disabilities, refer to the problems associated with acquiring a knowledge or skill in an academic area, which often manifests in the following aspects of learning: Listening (Receptive Language), Speaking (Expressive Language), Reading and Comprehension, Writing, Mathematical Calculation and Mathematical Reasoning.

According to the Rehabilitation Council of India (RCI) [6], the Indian education system has adopted the following definition for people with learning disability as stated by The Individuals with Disabilities Education Act (IDEA) [8], a United States Federal Law that mandates the aspects of early intervention, special education and related services to children with disabilities.

Specific Learning Disability means a disorder in one or more basic psychological processes involved in understanding or in using language, spoken or written that may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. The term does not apply to children who have learning problems that are primarily the result of

visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance or of environmental, cultural or economic disadvantage.

Learning disabilities are usually the outcomes of neurological problems. Children with learning disabilities are usually as intelligent as or better than their peers, but may find it difficult to perform any one or more of the above mentioned aspects, if taught in conventional ways. However, early identification followed with the right amount of support and intervention at a young age, can help these children to overcome their disabilities to a great extent. Early identification of such children is important for the following reasons: early diagnosis of children's needs and difficulties, obtaining appropriate aids and equipments for such children, better exposure to education, better psychosocial adjustment and better achievements [2].

2.1 Dyscalculia

Children identified as manifesting a learning disability in Mathematics often exhibit difficulties in mathematical calculations, mathematical reasoning or both. The general term used to refer to learning disabilities in mathematics is 'dyscalculia'. A math disability might occur as a single disorder or may co-exist along with other disorders.

According to the UK Department for Education and Skills [3], dyscalculia is a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence. The following list of indicators proves to be helpful for teachers to identify dyscalculic learners in the classrooms [1].

- An inability to subitise (perceive without counting) even very small quantities
- An inability to estimate whether a numerical answer is reasonable
- Weaknesses in both short-term and long-term memory
- An inability to count backwards reliably
- A weakness in visual and spatial orientation
- Directional (left/right) confusion
- Slow processing speeds when engaged in maths activities
- Trouble with sequencing
- A tendency not to notice patterns
- A problem with all aspects of money
- A marked delay in learning to read a clock to the time
- An inability to manage time in their daily lives.

2.2 Some challenges in providing successful intervention

Educationists often face many challenges in providing successful intervention strategies for students with learning disabilities. Some of them are:

- Difficulty in screening students with learning disabilities at an early age.

- Lack of human resources to provide individual care to students with learning disabilities.
- Developing individualized lesson plans catering to the individual's needs.

2.3 From Segregation to Inclusion

Early approaches to addressing the needs of special education started with segregation, which comprised of special schools or separate classrooms to address students with disabilities. Segregation often served to isolate students with disabilities from the mainstream and thereby isolated them from the society at large. This was followed by integration, where the students with learning disabilities were put in the same classrooms with the mainstream students. However the curriculum and other aspects of learning were not modified to the needs of the students with disabilities and they were not treated as equals with their peers. This was later modified by the present system of inclusive education, where the students with disabilities are treated as equal with their peers and the courses and materials for learning are restructured to suit the learning needs of all the students.

According to McGregor and Vogelsberg (as cited in [2]), children with disabilities in inclusive settings often have a more rigorous educational programme, resulting in improved skill acquisition and academic gains. Such children are also found to demonstrate high levels of social interaction with non-disabled peers when compared with segregated settings.

The educational model of Inclusive Education places emphasis on educating students with need for special education along with normal students in the same classroom and restructuring the education programme to the needs of all the students. This requires the professional development of faculty in schools to make them sensitive to the needs of students with learning disabilities and offer right interventions at the right time, so as to bring them to the mainstream and to strengthen a sense of self-confidence and belonging towards the society. There is also the need for a well-designed individualized education programme that is paced to the learning needs of the student.

With the evolution of the Internet, most of the learning programmes around the world are now beginning to come online, integrating faculty from learning centers around the globe. The latest development in this field is the wide-spread adoption of Massive Open Online Courses (MOOCs). This could offer a great solution for providing inclusive education, by providing individualized education program to the student in need of special education through online means and in the following sections, we explore the concept of MOOC and the possibility that it offers for educating students with learning disabilities.

3. MOOCs for the Learning Disabled

The goal of the paper is to present ideas towards development of MOOCs for Learning Disabilities in general with special focus on Dyscalculic children. MOOCs addressing the various aspects of learning disabilities could

be developed and hosted on the Internet by a panel of special education experts world-wide. The course content may include video lectures that are paced to students with specific learning disabilities. Specific interactive applets with multisensory capabilities could be designed to address and correct the problems of learning disabled by enforcing proven techniques of intervention. Interactive tools like writing tablets combined with these applets could be used to correct for students' writing disabilities in math. Much of the applets can be subject to gamification, combining learning with play to address attention deficits. Interleaved video and practice session reinforce the concepts learnt and enhance memory. This also reduces monotony of lectures.

Some of the MOOCs award badges to the students on successful completion of a specific learning objective. This system is intended to gamify the learning process and to make the students hooked on to the learning system through a sense of continued gratification. Completing these games would also boost a sense of self-confidence and self-esteem in the mind of the student. The system could also disguise various intervention methodologies into carefully crafted games that could arouse the interest in students and a continued and controlled addiction to this game could be used to re-inforce problem solving methodology in the mind of the student. A wealth of information would also be available to the educator / panel of experts when students play these games and interact with these exercises. The statistics of various problem solving aspects attached with these online games/tests can be used by the educator to understand problem areas in learning and implement corrective actions. The system can also perform grading automatically through tests administered online and relieves the educator from the burden of evaluation.

The system could also provide discussion forums where students can interact to solve assignments / clear doubts. Most of the time, the interactions between the students lead to the solution of the problems and the faculty have to just monitor the discussion board and flag the right answer. As a result, the doubt clearance for a larger audience is addressed very easily and the students participating in the discussion develop a greater peer interaction which can be monitored and corrected. This eases peer pressure in an Inclusive context, as the student is able to identify like-minded individuals around the world and locally, and develop a compatible peer environment, which lasts even after the course is completed.

The major advantage in this type of a learning system, is that the student can pursue the learning at the comfort of her/his home, after class hours. This contributes much to the aspect of Inclusive Education. The teacher/instructor in class could assign a student with learning disability to a particular online course. The student's performance in the course can be monitored by the teacher continuously and the grades awarded to the student could be used as a measure to understand if the condition of disability has been reasonably remedied. The concept of MOOCs could also be used to detect learning disabilities in students in a larger scale by making the students participate in an introductory online course and monitoring the results for signs of disabilities. This if done at an earlier age would help in the proper

detection and arrangement of intervention to correct the learning disability.

4. MOOCs for Children with Dyscalculia

The technology of Massive Open Online Courses could be utilized to provide support to children with learning disabilities in mathematics. Learning disabled students need to be taught in different ways rather than the conventional teaching methods and research has shown that computer based intervention programs have been successful in educating children with dyscalculia [4]. MOOCs provide a large array of audio visual tools through the internet to offer students with multisensory inputs. Students can be taught skills like counting, developing number sense, geometrical concepts through specially illustrated, slow paced, practice intensive and gamified learning lessons and highly interactive / playful quizzes. Skills like reading clock time and disabilities like directional (left/right) confusion, counting money, weakness in visual/spatial orientation, sequencing and pattern matching could also be corrected through playful exercises.

Students facing problems with slow processing speeds could be subjected to exercises that systematically build pace and correct for errors through practice tests and quizzes that provide a highly friendly and reassuring environment for the student to pace herself/himself. This would slowly build confidence in the student to perform calculations correctly and at better pace.

Illustrated and audio visual interactive lessons could be designed for students to perform validating checks on answers obtained as solutions to problems to check their reasonability. Students could be made to calculate and check for the reasonability of their answers and also develop a mentality to perform confirmatory checks whenever problems are solved.

Weaknesses in memory could be corrected by helping students to learn problem solving with the aid of mnemonics. Students could be taught the process of application of mnemonics to various problem scenarios through audio visual online classroom and exercises.

5. Conclusion

Much of the learning disabilities in Mathematics could be remedied through computer based audio visual animations and quizzes. Computers also provide a means to individualize the learning experience catering to the needs of the student. By combining the benefits of Massive Open Online Courses (MOOCs) with properly designed online intervention tools, highly standardized and proven techniques could be used to screen, intervene and correct students with learning disabilities in a world wide scale. This can compensate for lack of expert human resources in many developing countries like India and make the concept of inclusive education much easier to implement.

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