

Students with Disabilities and Their Aspirations in Science

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For a democratic and egalitarian society, education needs to be inclusive so that equal opportunities are made available to all students. However it has been found that only a few students with disabilities get enrolled in higher levels of education (NCPEDP, 2005). One of the reason behind this may be the present state of education which does not take into account the aspirations of students with disabilities (SWD). This paper reports on a study of the aspirations in science of 30 SWD students studying in classes VI to X in 6 different schools. The study is important for science education as it throws light on the aspirations of SWD and suggests ways to make science education more inclusive.

Introduction

For a democratic and egalitarian society education needs to be inclusive so as to provide equal opportunities to all students. According to UNESCO (1994), regular schools with an inclusive orientation are most effective in combating discriminatory attitudes, building an inclusive society and achieving 'education for all'. Research studies have demonstrated the effectiveness of inclusion in education practice, the positive effects on the educational outcomes of children with disabilities in inclusive settings (Katz & Mirenda, 2002) and the lack of any significant difference in the development of children with special needs in inclusive and special settings (Lal, 2005).

The term 'inclusion' in education is “a philosophical position as well as an arrangement of institutional facilities and processes. This is to ensure access to and conditions of success in education for everybody, including those in the margins, either with learning difficulties because of physical or mental disabilities or because of their social position. The aim is to create an integrated school setting, providing equal opportunities to children with special abilities, varied social backgrounds and diverse learning needs”- NCTE (2010 pp.13). But, it has been found through surveys that in India only a few students with disabilities get enrolled for higher education (Tables 1 & 2).

Category of disabled	Number	Source
In school going age	3430000	MHA (2001)
Children with disability having access to education with appropriate support	4% of the above	MSJE (2010)
Disabled youth in age range of attending Universities	3160000	NCPEDP (2005)
Percentage of disabled youth in Universities	1.2% of the above	NCPEDP (2005)

Table 1. Status of education of persons with disabilities in India

Students with Disabilities in Universities	No of Universities
Univ. having students with orthopaedic disabilities	1203
Univ. having students with visual impairments	311
Univ. having students with hearing impairments	38
Univ. having students with mental disabilities	22
Number of Universities with no SWD	38 (including TIFR)
Number of Universities not following 3% reservation for SWD	24 (including TIFR)

Table 2. Universities and education of students with disability (SWD), Source- NCPEDP, 2005

Aspirations

The term “aspirations” has several different meanings and for the purpose of this study it needs clarification. Ball and Wiley, (2005) state that aspirations of children are “a reflection of what they wish to become and subsequently guide a number of factors that impact what they will eventually do in life.” The importance of aspirations is highlighted by Sherwood (1989), who associates aspiration with goals and states that aspirations develop a will in students to “invest time, effort or money to attain a goal”. According to Quaglia and Cobb (1996), the term aspiration has the following meanings: goals, expectations, dreams, intentions and performance motivation. For the purpose of this study the meanings of the term that have been accepted are: goals, expectations and intentions. To initiate an inclusive transformation in science education, this study tries to explore the aspirations in science of SWD and also their perceptions of science, science education and inclusion in science education.

Tools and administration

To explore aspirations of students with disabilities in science, a questionnaire was developed which was based on the following research questions: How do students with disabilities (SWD) perceive science; do the careers they wish to pursue involve science; what careers do they prefer to pursue in science; what do they expect to learn in science; what difficulties do they face in learning science; what changes do they suggest in science education; and, what are their attitudes towards inclusion in science. The tool was validated by experts in science education and language and was pilot tested with 6 SWD. The final sample consisted of 30 students from 6 schools, and their disabilities were noted from the school records. Each student was coded on the basis of the following information: school, gender, standard, age, and type of disability. The tool was administered in the school premises and in groups except for the visually disabled. The details of the sample with codes is provided in Table 3.

Code of school	Gender	No. of students in class & Age	Types of disabilities
1. Government senior secondary school for girls	3 Girls	(3) VI std, (11, 12 & 14 yrs)	1 LV (Low vision) 1 OH (Orthopaedic disability) 1 SLD (Specific learning disability)
2. Government senior secondary schools for boys	11 Boys	(9) VI std (11 to 15 yrs) (2) X- std (18 yrs)	4 SLD (Specific learning disability) 1 CD (Cognitive disability) 1 Dwarfness 1 LMC (Lack of motor control) 3 OH (Orthopaedic disability) 1 LV (Low vision)
3. Inclusive school	7 Boys	(7) VI std, 11, 12, 14 to 17 yrs	4 OH, (Orthopaedic disability) 2 MD (Multiple disabilities) 1 VI (Visual Impairment)
	5 Girls	(5) VI std, 13 to 15 yrs	3 OH (Orthopaedic disability) 1 HI (Hearing Impairment) 1 HI&SI (Hearing & speech impairment)
4. Special schools for students with visual impairments	4 Boys	(3) VI- std, 15 to 17 yrs (1) X- std, 16 yrs	4 VI (Visual Impairment)

Table 3. Characteristics of the sample

Findings

What is science?

More than half the students (17) said that *science is an accumulated and systematised body of knowledge*. Six students stated that *science is a creator of technological product*, while for 3 students *science is a scientific*

method of investigation. For the student with Dwarfism, *science is a transcendental experience*, while a girl with orthopaedic disability (School1) felt that *science is something entertaining*. According to a boy with multiple disabilities from the inclusive school *science was magic*, for a boy with specific learning disability *science is a very good thing*, while another boy with specific learning difficulties from the same school equated *science* with a text book.

Science as a school subject

Of the given options, most of the students (28/30) stated that science was *very important* or *important*, while only 2 students (School3, bOH, bMD) felt that science is *absolutely unimportant*. It is interesting that one of these students (OH) had reported that science is a creator of technological products, while the other had perceived science as magic. Majority of the students (28/30) also felt that science is *very interesting* or *interesting*, while only one student (School2, bCD) found science *boring*, while another student (School4, bVI) stated that science was *somewhat interesting*. Most students (26/30) reported that science is *very useful* or *useful*, 2 students reported it to be *somewhat useful* (School3 bMD, gHI&SI), only 1 student (School2, bCD) found science to be *useless*, while another (School3 gOH) found science to be *absolutely useless*. Half of the students (16/30) reported that science is *very easy* or *easy*, 5 students found science to be *somewhat easy*, while 9 students responded that they found science as a subject *difficult* or *very difficult*.

Effect of science on students' lives

Around 13 students said that science *makes life easier*, 7 felt that it *promotes learning experiences* while 2 students felt that it *was an agent of change*. According to 2 students *science takes care of health* while one student (School4, bVI) *felt that it pollutes the environment*. According to a female student from school 3 who was orthopaedically handicapped, *science helps develop healthy eating habits*. A girl from the school with hearing impairment remarked that *science has no effect on their lives*, another girl from school 1 with visual impairment answered that she *did not know*, while a girl from school 3 with hearing and speech impairment did not respond to the question.

Success in school science

In response to the question, how can you get good marks in science, the comments of SWD can be summarised as: by *reading understanding and writing science, doing hard work, learning question-answers, revision, writing answers correctly, and through mental power*. Most of the students (22/30) affirmed that getting good marks in science means knowing science well, while only 5 students said that getting good marks in science does not necessarily mean that one knows science better (3 students gave unrelated answers). In response to the closed-ended question, what qualities are required to achieve a good understanding of science, most of the students selected the qualities of *experimentation* (27/30), *good memory* (26/30), *truthfulness* (26/30), and *observation* (24/30), *discipline* (22/30), *good understanding of content* (21/30), *analysis* (20/30), *patience* (18/30) and *good understanding of English* (18/30). About half the students selected *repeated practice* (15/30) and *categorisation* (12/30) as necessary for achieving a good understanding of science.

Preferred Career/Job/Profession

To the question what course of higher education would you like to go for, half of the students (16/30) stated that they wish to pursue *science*, 10 wished to pursue *arts* (which refers to humanities in the Indian context), 2 wished to pursue *commerce*, 2 wished to pursue *computer courses*, while 1 wished to pursue a *course of designing*. Interestingly all the 4 students from the special school for students with visual impairments wished to study *languages* (2 Hindi and 2 English) and one among them wished to pursue *English, Political science, History and Science* courses together. The job most preferred by SWD was that of *teacher* (9/30) and interestingly of these 5 were girls. The next preferred jobs were that of a *doctor* (6 students), *engineer* (2 students), *any government job* (2 students), *IAS officer* (2 students and both were from special school) and *cricketer* (2 students and both were OH). When asked what career would they undertake if they were good in science again the most preferred job was that of a *teacher* (9/30), *scientist* (7), *doctor* (6), *engineer* (4), *army personnel* (1), *policeman or doctor* (1), *work in a mobile shop* (1), *government job* (1) and *musician* (1).

Learning expectations from science

Some of the students' expectations were directly related to the knowledge domain of science (9 students) for example: *Knowledge of discoveries and discoverers* (School1, gLV), *questions and answers of science* (School1 gSLD, School2, bOH), *easy knowledge* (School2, bSLD, bOH), *becoming a doctor* (School2, bOH), *knowledge of solar system and making machines* (School3, bOH), *knowledge about nutrition* (School3, gOH) and

technological things (School4, bVI). Some expectations were related to the processes of science (18 students) like: *making drawings and pictures* (School2, two bSLD), *doing practicals in laboratory* (School2 bOH, School3 bOH), *doing projects* (School2 and School3 bOH), *scientific procedures* (School2 bLV, School3 bMD), *doing experiments* (School3, bOH, bMD1, bVI, gHI, gHI&SI, School4, VI), *activities* (School3 two gOH), *inventing and discovering things* (School4, bVI), *learning to become good human beings and assistants of scientists* (School4, bVI). Some learning areas were related to the general education (School2 bSLD, bDW, bLMC) like: *spellings; understanding nicely, reading, and writing*.

Suggestions for science education

Some suggestions given by students to make science education interesting involved: *making the study of science like a game* (School1, gLV), *making the way of reading interesting* (School1, gSLD), *making science understandable* (School2, bSLD), *studying with concentration* (School2, bSLD), *making jokes* (School2, bSLD), *reading and writing correctly* (School2, bSLD), *through happiness* (School2, bCD1), *understanding and obeying science* (School2 bDW), *reading, writing and sitting silently* (School2, bLMC), *through understandable tasks* (School2, bOH), *making use of technology of science and doing miracles of science* (School2, bOH), *through enjoyment and concentration* (School2, bOH), *paying attention to teacher's words* (School2, bLV), *games* (School3 bOH, three students), *supplementing theory with practicals* (School3, bOH), *experiments* (School3 bMD, two students, and bVI, gOH), *activities* (School3, gOH, two students), *by understanding what is science and by doing experiments* (School4, VI), *stories along with serious subject matter* (School4 VI), *knowledge about changing World* (School4 VI), *diagrams* (School4 VI).

Knowing the expectations and suggestions of SWD can be helpful in curriculum guidelines for the content, process and the environmental validity of an 'ideal inclusive science curriculum'. Some of the expectations and suggestions made by SWD are acknowledged as principles to be adopted in science curriculum. An important expectation/suggestion put forward by three SWD is the learning of drawings and diagrams in science learning to make it more interesting and effective. In fact drawings and diagrams are an important tool in science for focused observation, understanding and visualisation not only for SWD but for all students. Raised line diagrams have been suggested by Carney, Engbretson, Scammell and Sheppard (2003) for teaching science to students with visual impairments. Conducting experiments, doing activities, practicals and projects were mentioned by 18 of the students as their expectation or suggestions for science education, suggesting the importance of the same for them.

Attitude towards teaching science to SWD

Most of the students (26/30) had a positive attitude towards inclusion of SWD in science. Some of the reasons given were; 2bDW- "*Science has a speciality... science is made for disabled students*", 4bVI- "*If God has snatched the vision then... we can do so much... even... if not scientist... we can do something in future*". However four boys from school 2 (two with SLD, one OH and one LV) stated that science should not be taught to those with disabilities for example, LV said, "*No, because they do not study science properly and are unable to understand alphabets written in science text book*".

Difficulties faced in science

The students were asked what difficulties they faced in learning science as also the difficulties of all students while learning science and those specifically of SWD. The responses are presented in Table 3.

Difficulties	Questions asked	Diff. you face while learning science?	Diff. faced by all students while learning science?	Specific diff. faced by SWD while learning science?
Understanding science		3 students	10 students	6 students
Sensory and cognitive difficulties		4 students	7 students	14 students
Reading and writing		8 students	4 students	4 students
Memorising		4 students	1 student	
Answering the questions of science		3 students	1 student	
Lack of concentration		1 student	1 student	
Drawing & visualising diagrams		2 students		2 students
Revision		1 student		

Doing practicals	1student		
Lack of laboratory facility	1student		
Lack of knowledge of English	1student		
Difficult words		4 students	
Irrelevant curriculum & lack of text-books		1student	
Disturbance due to treatment			1student
Doing activities that need locomotion or sitting			4 students
Responding through speech			3 students
Do not face difficulty	10 students	2 students	3 students
Unrelated response	1student	2 students	3 students

Table 4. Number of SWD giving responses in particular category, to the questions asked

Conclusions

The study reports the perceptions and aspirations of 30 SWD from classes VI and X of six different schools with respect to science and suggests ways to make science education more inclusive. Most of the SWD have positive attitude towards science, and perceive science as important, interesting and useful. The most commonly held views of SWD about nature of science are “*science is an accumulated and systematised body of knowledge*” and “*science as a creator of technological products*”.

The SWD in the present study found science difficult due to their inability to understand science and due to some cognitive or sensory disability. The reason for their inability to understand may be derived from the India Science Report (Shukla, 2005), which states that 40% of general students who did not opt science at senior secondary level did so because “the number of students in a class were too many for them to understand what was being taught”. Some students also report that very difficult words and inability of students to read and write also cause great difficulty in learning science.

From Table-4, it can be noted that there are some specific difficulties that are faced only by SWD, such as, drawing and visualising diagrams, revision, doing practicals, lack of laboratory facilities, lack of knowledge of English, disturbance due to medical treatment, doing activities that need locomotion or prolonged sitting, and responding verbally. The sample SWD also reported that all students face difficulties in understanding science, due to sensory & cognitive difficulties, difficulties in reading, writing, memorising, answering the questions of science, lack of concentration, difficult words and irrelevant curriculum and lack of text-books. On comparing the general students of +2 level in the India Science Report (2005), where a third said “they did not study science as they did not feel motivated enough”, we find that the SWD are generally motivated to study science but, it is due to the stated difficulties that they are unable to opt for science at higher levels. It is also important to note that 8 of the 12 students from the inclusive school responded that they do not face difficulties in learning science indicating better science education facilities for SWD there.

The present study reports that in order to get good marks in science, according to SWD they need: reading, understanding and writing of science, hard work, learning question-answers, revisions, writing answers correctly- all of which are similar to the difficulties that they report they face in science. This may lead to a need of extra 'hard work' for SWD or lower grades in science examinations, thus causing problems in their opting for science at higher levels.

The SWD showed interest in a vast spectrum of interesting areas of science which they wish to explore and learn. It is interesting that the number of students who wish to learn processes of science is almost double to those students wanting to learn different areas of knowledge in science. The suggestions given by students are very important as these suggestions have been given by the very target group which is the focus of various experimentations, seminars, and workshops and for whom various policies of inclusion are being brought forward. Another important point is that the implementation of these suggestions such as focussing on activities, experiments, practicals, projects and drawings and diagrams would make science more interesting, useful and effective not only for SWD but also for all students with diverse learning needs and diverse backgrounds.

A positive finding is that science is the most preferred subject for SWD for higher education (16/30). This is comparable to the 60% of general students at the class six to eight level in the India Science Report (Shukla, 2005), who wanted to pursue some science course at higher level of education. A high value for science is

demonstrated by SWD through their preference of science related jobs like, doctors, engineers and scientists. The study is in accordance with Bevins, Brodie & Brodie's (2005), study which reports a contrast between a small number of students from industrialised societies having aspirations to become scientists or technologists and the high value of careers in science and technology for school students from developing countries. But sadly in India only a few SWD get enrolled in courses having science background (refer Tables 1 & 2), and they are almost invisible in science related jobs.

An important finding is the preference of SWD for the profession of teacher. Being a teacher is their choice in both instances- their first choice and also in case of their being good in science. Scientists, doctors and engineers were the second, third and fourth most popular professions respectively. This finding is similar to the choices made by general students of classes VI to XII, as reported in the India Science Report, where the three most preferred professions of students were teacher, doctor and engineer (Shukla, 2005).

Implications and limitations

This study presents how SWD perceive science, their high aspirations and their positive attitude towards science as well as the difficulties faced by them in learning science. The students themselves have reported their areas of interest and suggested ways to make science more interesting, useful and effective. These suggestions have implications for the curriculum developers to help them incorporate these while developing an inclusive science curriculum. These findings indicate that there is a gap between the high aspirations of SWD in science and the meagre status of enrolment of SWD in science courses for higher education and in turn in the jobs requiring science backgrounds. In this study more students from inclusive settings reported not facing difficulties in science this indicates better science education conditions in inclusive settings.

It is important to note that the process of inclusion is not only beneficial to students from diverse abilities and disabilities, but it would also be beneficial to science education as a whole. To bring about meaningful progress in science education we need to incorporate the diverse abilities, backgrounds and experiences of students and teachers.

The study is limited as we have not collected responses of general students from the inclusive and non-inclusive settings, which could be compared with the responses of SWD. The small sample also hinders the comparison of responses between the students from different educational settings, namely general school, inclusive school and special school, and also between students with different disabilities.

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