

## Plights of learners with Visual Impairments in Rwandan science classes: Evidencing teachers' practice in HVP Gatagara

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### **Abstract**

*The Nine Year Basic Education (9YBE) program in Rwanda is seemingly a national initiative that brings free primary and secondary education services closer to local communities, and renders secondary education and ultimately professional training more accessible to all, including the many disadvantaged children. Having noted with concern that Visually Impaired Students (VIS), like other learners with Special Educational Needs (SEN), are increasingly enabled to access this standard of education, the present study has been prompted to investigate their plights, evidenced by the persistent poor academic performance of this category of students. The gap is most particularly evident in science and mathematics subjects, and becomes more conspicuous as the students progress through higher levels of their schooling. The article is thus an outcome of a study conducted in HVP Gatagara – Rwamagana, the only 9YBE school for the VIS in Rwanda, and the finding underlines the fact that the planning of alternative solutions ought not to focus on the VIS as the source of the problem, rather on their school and whole education system's incapacity to offer appropriate adaptations and enabling provisions.*

**Key words:** *Visual Impairments, special educational needs, appropriate school adaptations, alternative provisions.*

### **Introduction**

Like other communities of the sub-region, Rwandan people with disabilities still find themselves in situations of educational marginalization and exclusion (Charlton, 2000, EENET, 2003; Vaneste, 1997). One of the evident indicators is their under-representation in education and professional training, and subsequently in the working communities. Though this situation may arguably seem to be improving with the recent socio-political transformations in Rwanda, that includes enacting laws and policies that fosters their participations at varying levels of decision making and valuing their status in the Rwandan society, their generalized lack of education and training continue to subject them, to a large extent, into a vicious cycle of marginalization, dependency and poverty. Based on the descriptive terminology that is still contemptuously leveled against the disabled in the local languages and cultural concepts (Karangwa, Ghesquiere & Devlieger, 2007), it cannot be ruled out that some of the Rwandan communities still regard them as equal members of the society. Besides, there are no evidences yet that disapprove old popular beliefs that disability is a curse of ancestors to the family, is an incarnation of bad spirits, is a result of a mistaken conjugal relationships, and other mythical perceptions that still linger within many communities of the sub-region including those in Rwanda (Karangwa; Miles, & Lewis, 2010). It is with this background that the present paper investigates schooling for children with profound visual disabilities in Rwanda, with particular interest in their performance in science subjects. HVP Gatagara-Rwamagana School, the first center for the disabled established in Rwanda by Home de la Vierge des Pauvre (HVP), a Roman Catholic Organization, was particularly found suitable for the study.

Ever since the promulgation of the Rwandan Constitution (Republic of Rwanda, 2003a) in June 2003, successive policy documents have continued to pledge the government commitment to the support of its citizens with disabilities, recognizing education services as a fundamental right and an essential tool to ensure that all Rwandans, irrespective of their gender, background and disability realize their full potential and contribution to national development (Education for all Plan, 2003, Education Sector Strategic Plan 2010-2015, Law No. 1/2007- Art. 11-13 of 20<sup>th</sup> May 2007). In its Article 40, the National Constitution of June 2003 for one, state that '*Every person has the right to education*' and goes on to emphasize that '*the state has the duty to take special measures to facilitate the education of disabled people*'. It is in the same vein that the education sector policy in the same year pointed out that:

*"... The number of children in Rwanda with special educational needs comprises a much larger proportion of the school-age population than would normally be expected, due to the war and genocide. In particular, the disabled, orphans, street children and child heads of family represent particularly vulnerable groups for whom special provision is needed either within the ordinary school system or in special facilities ... There is no special consideration for the highly gifted children. In general, special needs education has not been given much attention in Rwanda and there is a lack of specialist equipment and trained teachers for special needs education"* (Republic of Rwanda, 2003b: 13).

The same policy documents express the Rwandan Government commitment to International Development Targets and standards in accordance to the Millennium Development Goals (MDG), Education for All (EFA) by 2015 (UNESCO, 2005) and others. As a matter of fact, Rwanda economic development planning strategies seem to be convinced that Education provides the human capital necessary for poverty reduction, by making available the kind of capital to which the majority of the population will easily proximate and utilize affordably (Republic of Rwanda, 2007, Republic of Rwanda, 2010). Accordingly, the present work recognizes that the education and training of young citizens with disabilities and other special needs addresses closely this important development strategy.

It is within this framework that the number of schools and centers that cater for education and rehabilitation of children with disabilities and other SEN have been on the increase since 2003, and ordinary primary schools in all provinces of the country (mainly in Eastern, Southern and Kigali provinces) have increasingly developed catch-up and child-friendly school programs in which barriers to learners with disabilities and other SENs are addressed (TFDIER Reports, 2008-12<sup>2</sup>). The present study therefore, has exclusively paid attention to the education of the Visually Impaired Learners, with particular attention to their attainment in science-related subjects. Aware of two other schools educating visually impaired learners (G.S. Gahini in the Eastern province and HVP Gatagara-Huye in the southern Province), and having noted with interest that learners who complete the schools also indicate poor grades in sciences, the study prefers to focus its investigation on HVP-Gatagara special school of Rwamagana in Eastern Province (exclusively for Visually Impaired children). This is mainly because it is the only 9YBE and a special school that offers a suitable setting for the study interests which also entails an analytical evaluation of the 9YBE national program that ought to work for all learners.

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<sup>2</sup>The Task Force for the Development of Inclusive Education in Rwanda (TFDIER), is a voluntary committee initiated by the Ministry of Education in 2007, and has both worked with the civil society and public organs in education of children with disabilities.

### *Background aspects of education for the blind in Rwanda*

Today, nations are increasingly adopting and reinforcing anti-discriminatory policy and education reforms, and educational settings and communities continue to discourage all forms of prejudices that promote social inequalities and marginalizing attitudes such as racism, sexism, disablism, name-calling, bullying, etc (UNESCO, 2005, Stocker, 2002). However, the present study insists that discrimination against people with disabilities persists in all societies (Charlton, 2000), and though it is more pronounced in some than others, the general view is that the prejudiced attitudes today have their foundations in longstanding cultural and historical background influences. In other words, cultural attitudes and images of the disabled today; continually draw from the past, usually fossilized in myths, cultural beliefs, literature, theatre, folklore, biography and history and even established and acceptable daily cultural practice (Albrecht and Verbrugge, 2000).

Accordingly, the present papers maintains that having a clear understanding of where the thinking about disability has come from is crucial in order to get clearly the underlying negative attitudes and stereotypes within the society that also influence its development programs. As the study looks into the education of the visually impaired for example, the background of Rwandan education like elsewhere in Africa cannot be disassociated with the strong influence of the Western values and norms that dominated its initiation and development in much of the last century and has paved the practice for the current situation. Yet, for quite a dominant part of its history, the West is known to draw irretrievably from aspects of a civilization tinted with gross discriminatory cultures and practices. Notably the Greek and Roman civilizations known for exalting what was perceived as beautiful or athletic bodies, discrediting the so-called 'inadequate or incomplete human bodies' (Lynn, 1968, Hursthouse, 1997, Epictetus, 1966). Aristotle (384 BC-322 BC) for example, the famous Greek philosopher whose writings encompassed morality, athletics, logic, science, politics, and metaphysics, and widely recognized as the most important founding figure of Western Philosophy, also advised getting rid of a child if it was imperfect. Earlier Western religious sects dominated by Christianity that encouraged alienation or hostility and Puritanism vis-à-vis other beliefs, are known to draw largely from such civilizations, and later instilling related values through evangelization and colonial education, and consequently embedding some of these into the African cultures and education systems still maintained today.

Such beliefs and perceptions about disabilities were maintained and established in most of the civilizations and cultures since the onset of the European influences up to the beginning of present century. The 15<sup>th</sup> century Martin Luther, the renowned founder of Protestantism, speaking of congenitally impaired children for example, said: "*Take the changeling child to the river and drown it.*" The Bible, one of the most influential books that shaped Western cultures and colonial education, is known to contain many references that are negative towards disabled people, e.g. the Book of Leviticus says that if you are a disabled person you can't be a priest or take communion:

*"For the generations to come, none of your descendants who have defects may come near to offer the food of his God. <sup>18</sup>No man who has any defect may come near: no man who is blind or lame, disfigured or deformed; <sup>19</sup>no man with a crippled foot or hand, <sup>20</sup>or who is a hunchbacked or a dwarf, or who has any eye defect, or who has festering or running sores or damaged testicles"* (Leviticus, 21: 17-20).

In the New Testament, sin and disability are paralleled: “*But to prove to you that the Son of man has authority on earth to forgive sins, -- he said to the paralyzed man: 'I order you: get up, and pick up your stretcher and go home'*”(Luke. 5: 24). In John (9) Jesus cures blindness, and the disability is seen as a punishment from God, ‘*be cured if you sin no more*’. Such teachings and ideologies are possible explanations of the promulgations such as the UK Mental Deficiency Act of 1913 (abolished by the Mental Health Act of 1959) that categorized disabled people as *idiots; imbeciles; feeble minded; Moral defective*. Educators in Rwanda should possibly be reminded that teacher training curriculum in Rwanda had used similar categorization of disability in some pedagogical courses until late 2000s, the program that was largely inherited from the colonial teacher training curriculum, and had never been reviewed to match the changes in attitudes, until Kigali Institute of Education was entrusted with all Rwandan teacher training programs in 2011.

### *Education for the blind in Rwanda*

It should not be construed to imply that ancient Western cultures were fully responsible for the persistent misunderstandings of disability and mistreatments of people with disabilities. In his work, ‘*Rehabilitating Aristotle*’ that denies the epoch’s widespread mistreatment of the disabled, Merriam (2010) reaffirms that there are also cases of compassionate treatment of people with disabilities that have laid a foundation for the present period of emancipation and inclusion of people with disabilities. However, it is a reality that the colonial governments accorded hardly any consideration to education of this category of learners in Rwanda, and governments that succeeded each other afterwards also followed suit, for they were covert disciples of the former. Up to 1994, only five small centers were known to cater for children with disabilities in Rwanda, and were run exclusively by charitable organizations of missionaries. Home de la Vierge des Pauvres, (HVP) Gatagara, is actually the oldest as explained below.

It was in 1962, when a compassionate Belgian priest called Fr. Joseph Fraipont (1919-1982), deeply touched by the misery and difficulties the Rwandan children with disabilities lived in, founded HVP center for young Rwandans with disabilities at Gatagara, in the current Nyanza District of the Southern Province. Until late 1990s, it was the only center that cared, educated, and reintegrated physically and visually disabled persons in Rwanda. By 1979, Fr Joseph Fraipont, then Nationalized as Rwandan with the name ‘Ndagijimana’, had established and equipped a special school for children with physical and visual disabilities, and schooling for blind children begun in September 1979 at HVP Gatagara with a primary school section. It remained so until 1997 when G.S. Gahini opened its doors for their integration in secondary education. Before that, there had been no secondary level schooling for such category of learners in Rwanda, and

Figure 1: The 50<sup>th</sup> commemoration of Fr Joseph Fraipont, the founder of HVP Gatagara was celebrated on 29<sup>th</sup> May, 2010



usually children would have to go back to their respective home villages after their primary school education. Before he died on 26<sup>th</sup> May, 1982, Fr Joseph Fraipont had entrusted the center to the Brothers of Charity (a Catholic order), and had worked out with the latter vocational training programs that included laboratory and electronics for those with physical disabilities, physiotherapy and music for the visually impaired.

G.S. Gahini became the first secondary school in the country to open its doors to children with visual impairment (EENET, 2003), and was joined by HVP-Gatagara–Huye and HVP-Gatagara - Rwamagana latter in 2000s, both of which are the extensions of HVP Gatagara of Nyanza, initiated by Fr Fraipont forty years earlier. At the time of this study (2011), the school had been upgraded to a nine year basic education (9YBE) since 2010 by the Ministry of Education, with a total of 178 students (142 in the primary section and 36 in Ordinary Level), and 24 educators (including school administrators). This implies that the school operates both a Primary section (P1-P6) and a lower secondary section (O-Level: S1-S3), and by the year 2012, it had started the Advanced Level with S4, dispensing English-Kinyarwanda-Kiswahili combination only and *'not'* sciences.

The discouragement (if not failure) of the students in science subjects at higher levels, is conspicuously noticed, which is the phenomenon that has prompted the focus of the present study. The clearly emerging issue for inquiry thus, is the 'special educational needs' due to Visual Impairments and the links of these with science education'.

### *Visual Impairment (VI) and related special educational needs*

According to Mani (1997), the term low vision means "*marked reduced functional vision in an individual*" and the visual condition may demand large print materials and magnifiers for reading. On the other hand, blindness refers to complete loss of vision that cannot be corrected by any optical instruments. Accordingly, students with Visual



*Figure 2: Visually Impaired Learners of HVP Gatagara-Rwamagana in their initiation to numeracy & literacy through tactile materials*

Impairments (VI) refer to a wide range of categories of learners with visual difficulties, notably: *low vision or partially sighted; peripheral and tunnel vision; and functionally blind* (partially or totally). The difference between the categories depends on the degree and type of visual difficulties. For instance, learners with Albinism are usually partially sighted or have limited sight that they use to some extent with modifications and corrective lenses. On the other hand, totally blind or simply blind students cannot use their sight, and depend entirely on other senses for all functions.

Students of HVP-Gatagara therefore, are usually required to report with a medical specialist's report before their admission to the institution to prove their visual conditions. Two categories of visually impaired children are currently admitted: (a) *totally blind children who cannot see* (b) *children with very limited vision or partial sightedness*. The present study was particularly interested in both categories of



learners because they do not depend on the ordinary approaches in the learning process, but learn by using alternative approaches, notably tactile means (using the sense of touch), and/or relying on the hearing. The demand of such students for unconventional or alternative approaches and tools in their learning and teaching process is often referred to as Special Educational Needs (SEN). The Ugandan Policy (Republic of Uganda, 2012) for example states that it targets learners with special learning needs (Barriers to ordinary learning and development provisions), and among the ten categories highlighted by the document, features the learners with visual impairments (p. 14). Heward and Orlansky (1992), define children with special educational needs as: “... those whose differences from the norm are large enough to require a specially designed instructional program if they are to benefit fully from education ...” (p. 8-9).

In the same way, HVP Gatagara, is considered as a special school because it strictly educates learners with Visual Impairments, relying almost entirely on Braille and other tactile resources instead of printed materials as indicated in Figures 1 & 2. As explained in the next sections therefore, the present study is concerned that whereas experiences in Rwanda has proven that children with visual impairments are able to achieve in school as their sighted peers of the same age, and have even reached the University levels (EENET, 2008), there has been an observable tendency to strictly opt for professional studies related to language and arts such as Journalism, Law, Psychology and others, but never any Science studies.

### *The study focus*

It is with the above background concerns therefore that the present study is restricted to the learning and teaching of Science subjects in HVP Gatagara-Rwamagana. It was undertaken to investigate the general situation in the school, and the facilitation of learning and teaching of sciences in place. It was expected that any challenges and alternative solutions would be perceived during the research field intervention. The study would focus specifically at the basic secondary education levels of schooling, where complex concepts in Mathematics, Physics, Chemistry and Biology are reinforced with practical and experimental ideas. It is by investigating their achievement at this critical stage of learning and development that educational needs and other issues affecting their attainment and progress were expected to emerge. The study intended specifically to investigate:

- The challenges encountered in learning science subjects at the 9YB levels,
- The approaches used by teachers of HVP-Gatagara-Rwamagana and the learning processes.
- The educational provisions at the teachers’ disposal and the general teaching-learning environment.

It was expected that the focus on the three key components of education practice encompasses issues related to special educational needs of visually impaired learners, and HVP-Gatagara-Rwamagana being the most



**Figure 1:** Teachers of HVP Gatagara indicating some of the sections of the school books that they find difficult to transcribe into Braille for VIS.

established in educating this category of learners, it offered a significantly suitable field of study from which the outcomes would inform the wider Rwandan education sector.

### *The study methodology*

The research approach was purposively planned and simple in nature, aimed at discerning data for ultimate analytical processing. Science teachers, their activities and resources were of particular interest to the investigation, for they were central to the study focus. Having sampled the study population, curved out the scope and focus, the research was conducted using the following traditional tools: literature review, observation of the teaching and learning processes; and guided interviews. The research tools were administered in science classes of lower secondary sections of schooling, focusing on the students' and teachers' activities as well as the whole school educational system. Thus, 9 students per level, 3 science teachers and the administrative staff composed the samples for the study.

The approach essentially suggests more of qualitative than quantitative approaches, and the data is collected mainly in narrative form, which was subjected to thorough coding. Through categorization of the latter, triangular measures were adopted to ensure logical and reliable conclusions or claims (Yin, 1994, Denzin and Lincoln, 2000). The measures were also useful not only in underpinning reliability during data collection process, but also enabled the study to refine and focus the data analysis procedures (Silverman, 2000). The outcomes of this methodological data collection and analysis therefore, lead to the findings presented in the next sections.

### *The findings*

As highlighted previously, it was noted on the first encounter with VIS during their learning activities, that they encounter enormous challenges while learning science and related subjects (Mani, 1997), and these hinged on three interrelated limitations:

- Restriction on the range and variety of learning experiences,
- Restriction on the ability to interact freely within the learning environment,
- Limitations on the control of the environment and in relation to the learning process.

Accordingly, it was made obvious during the research intervention within the classrooms, that the limitations above may impose general difficulties to VIS; however, learning mathematics and other science subjects may also bring additional problems because these are commonly taught with visual aids and concepts. In fact, learning science without the visual aids, concepts become abstract, or are deprived of their concrete meanings and therefore, not easily comprehended during the learning experiences.

Although Visually Impaired Students (VIS) can read by using tactile methods (Braille), this approach becomes useless when it comes to graphic representation of mathematical and scientific concepts, practical experiments, colors, symbols, graphs, drawings and others (See Figure 3). The study noted with surprise too that HVP Gatagara receives regularly school books from the Rwanda Education Board meant for sighted learners, despite the constant reminder by its administration that these are of no use to their non-sighted learners, and their demands for tactile alternatives are reportedly ignored. Besides, the school was not guided by the national curriculum because there is none meant exclusively for learners with special educational needs, let alone the visually impaired. What was evident in the school however, are the adapted resource provisions meant for VIS' alternative learning approaches through hearing or/and tactile means, though not adequate enough. In other words, most of the printed and visual materials is translated electronically either directly or using specialized software, into tactile or sound for VIS. The problem arises however in science subjects, because only a limited number of concepts taught are transcribed accurately, and in turn, what is attained by VIS is equally limited.

### *Mathematics*

Learning mathematics by VIS seems to present particular challenges, indicating much slower attainment levels compared to sighted students of same age and level, prompting the question as to whether the difficulty is intrinsically motivated by the impairment, or is extrinsically motivated by the inadequately adapted teaching and learning system.

To this end, it was evident to the study that due to the visual limitation of the VIS, approaches and devices generally used by teachers in solving mathematical problems, restricted the organization of idea in a logical form, in order to make Math concepts easily comprehensible to the learners. However, though abacus tools used at basic levels rendered arithmetic palpable and easy; calculus, algebra, geometry and other concepts learnt at advanced levels are comparatively difficult and sometimes impossible for VIS to interpret and comprehend. This is more so because most of the teachers lack appropriate skills and means to render these tactile or comprehensible. All mathematical concepts were explained orally, and few others in tactile forms, including matrices, geometry, and other concepts that involve drawings and complex equations. One of the teachers of HVP-Gatagara-Rwamagana emphasized this problem exclaiming for example:

*"In our ordinary classroom work, teaching of mathematics is done by using the blackboard, supplemented by oral instructions. Ordinary children grasp the idea of organizing and sequencing mostly by the manner in which the matter is presented on the blackboard. Due to their visual limitations on the other hand, blind students miss this very crucial learning process"* (Field notes, 17<sup>th</sup> September, 2012).

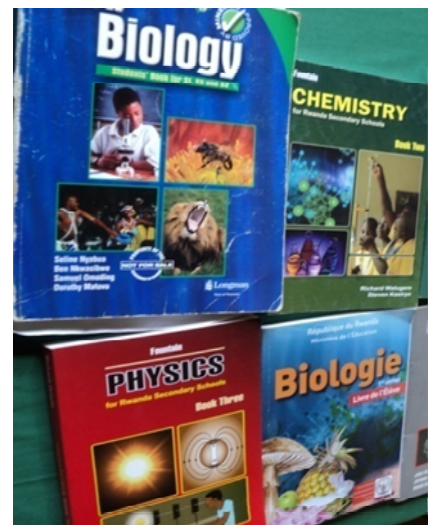


Figure 2: Some of the science books in HVP Gatagara library shelves that are not usable by students



Quite obvious in the teacher's words, is the fact that the problem resides in the learners' inability to cope with the ordinary approaches and methods of teaching and learning Math. However, the present study adds that it would as well be equally important for the teacher to perceive the problem from his own inability to identify the specific educational needs of the learner, and consequently, design corresponding response mechanisms.

The difficulty is evidenced by the problem of transcribing mathematical concepts into tactile version decipherable by VIS (See Table 1). Concepts expressed through equations or/and formulae, notably, calculus that deals with interpretation of two and three dimensional graphs and how those graphs are related to the mathematical equations, teachers affirm that they find it difficult to enable VIS to access all the information. In brief, the traditional teaching aids and methodology continue to prevail in the learning and teaching process in HVP, and is one of the likely key sources of barriers to learning of mathematics by VIS.

### *Science for Visually Impaired learners*

It is an established fact that science teaching and learning at secondary school levels is also characterized by measurements and observations in experiments of concrete objects, most especially in the Biology, Chemistry, Physics and related subjects curriculums. For learners to grasp new concepts in these subjects without any practical experimentation are inconceivable in any standard educational practice. For example in chemistry, students are expected to measure weights and volumes of chemicals, or solutions. Chemical reactions are expected to be followed through visual observations for their color changes and ranges; formation process of chemical products, precipitation, evolution of gases formations, etc. In fact almost all measuring instruments in science require visual perceptive of the experimental outcomes, which is central to science.

In this regard, it is also implied that science concepts accessible to visually impaired students of HVP Gatagara, like elsewhere in Rwandan schools where this category of children is taught, is actually very limited. Showing concepts in science school books (See Figures 3 & 4) that are difficult to teach, the teacher pointed to a chemical experiment that involved gases (Carbon Dioxide and Ammonia) and explained:

*"I can possibly explain about the gases and other chemicals in practical experiments theoretically, and let the learner smell some of them and touch or hear some of the experiment sounds, but many of them are highly poisonous and the outcomes of the experiments cannot be understood through touching or smelling"* (Field notes, 17<sup>th</sup> September, 2012).

Besides, in writing chemical formulae, Braille alphabets seem to have either confusing representations of some of the signs, e.g.  $\delta, \lambda, \sigma, \varphi$ , etc, or figures that are used as superscripts and subscripts are not represented in Braille alphabet (See table 1).

Teaching sciences takes place in most cases through laboratory experiments and manipulation of science materials, chemicals and related resources, all of which renders the learning dangerous and unsafe for VIS, requiring exceptional safety measures in laboratory environments. The study conclusively finds that all dimensions of science

education are made difficult for VIS in HVP Gatagara, as long as all media through which learning and teaching take place continue to present barriers.

### *Students with Visual Impairments*

Interview with Visually Impaired Students and observations in their classrooms clearly revealed that the major difficulties learners of HVP Gatagara face are not necessarily associated with their disabilities, but with external problems that include:

- Inadequacy of adapted teaching aids such as recorders to tape lessons, resources used in drawings, tactile maps and resources used to represent geometrical and other mathematical symbols, etc.
- Teachers' limited skills in handling special educational needs associated with VIS, as well as their inadequacy in handling alternative teaching resources.

It was through the same field interventions that it emerged clearly that despite their impairments, learners with Visual Impairments are able to achieve in science as successfully as their sighted peers, as long as all learning and teaching media is rendered accessible and fully available to both the VIS and their teachers. This assertion was actually emphasized by a science teacher of HVP Gatagara who, pointing at one of the students who had been newly registered in the school from Shyanda regular School:

*"... you see, his Braille skills were limited because he had spent five years in a regular school depending almost entirely on his memory to learn, as well as other abilities such as speech to communicate his knowledge, but for the last few days he has been here, he has been able to learn Braille and acquire key tactile skills, and due to his relatively sharpened memory he is able to grasp math and science concepts much more easily than peers to whom these still appear too abstract"* (Field Notes, 22<sup>nd</sup> October, 2012).

However, despite the demonstration of exceptional capacities, reportedly owed mostly to his background learning experiences, the above student also shares problems with other HVP Gatagara VIS that include:

- Inability to perform in conventional laboratory experiments, and therefore, underachieving in sciences;
- Because the national curriculum and resources are only adapted to ordinary learners, the attainment level in science subjects by VIS in HVP Gatagara generally falls below average;
- Both individual and school-based educational materials adapted for VIS are inadequate, especially due to insufficiency of funds.

Essentially, what seems to emerge as a fact about the VIS of HVP Gatagara is that their learning processes of science and mathematics is not fully supported, because they are mainly adopted from the national curriculum, which is meant for ordinary students' learning/teaching style, and therefore, the school continues to function within the dire demand for the school adjustments to fit VIS educational needs.

### *Teaching of Visually Impaired learners*

It was also underlined in previous sections as key findings that many factors determine the academic attainment levels of VIS, and among those that seem to emerge as crucial in HVP Gatagara School are teachers, because they

are agents of the educational process. The innovative performance and challenges faced by the latter in their teaching process determine the achievement levels of VIS. The following teachers' views were summed up from field notes:

- *It is not easy to teach science to VIS because most concepts in science can only be communicated orally. ... one has to be highly innovative, taking into consideration the learners' unconventional capacities, their limitations and making good use of the resources available to the teacher (p.6 Science teacher).*
- *Teaching VIS requires being very slow during the teaching process, and even in dictating notes, it involves the disturbance of the normal classroom process and/or distortion of the ordinary syllabus (S1 Physics and Math teacher).*
- *We are not updated of any Braille transcription of science formulae, such as special symbols, indices, powers, etc (S3 Math and physics teacher).*
- *All these Braille codes are confusing, since most of us (teachers) have limited Braille literacy (S2 Biology and Chemistry teacher).*

As far as the present study is concerned, the HVP Gatagara teachers' views above actually bring out mainly their limitations in both resources and skills, and with which they are able to support the learners. Table 1 below indicates some of the examples of the transcriptions that often go wrong when teachers teaching some concepts into Braille. The teachers' situation was in fact

Table 1: *Examples of inappropriate Braille transcriptions*

Normal writing	Braille transcriptions
Sulphuric acid: $H_2SO_4$	H2SO4
Sulphate: $SO_4^{-2}$	SO4-2
Ten power five: $10^5$	105

summed up by one of the science teachers' interviews as:

- Inability to explain scientific concepts through practical and concrete means;
- Insufficient or inappropriate teaching resources (Including ICT tools) available to teachers of sciences;
- Insufficient knowledge and skills in using available teaching aids, especially in the field of teaching science to VIS.

In a way, the emerging challenges of the HVP Gatagara teachers appears to bring out two important requirements of all educators in similar educational settings: 1. The needs for training to adapt their skills to the educational needs of their students; 2. Equipping both the learners and the teachers with adequate and appropriate resources, with which to reduce all learning and teaching barriers encountered. The present study adds too that teachers' positive attitude towards school achievement is very fundamental.

#### *Performance of teachers and learners in HVP-Gatagara*

According to all the teachers interviewed in HVP-Gatagara-Rwamagana, the traditional approach is still commonly used while teaching mathematics and sciences. They explained that usually a concept is introduced orally to the learners; while the latter pay attention and take notes in Braille, they are accorded time to ask questions and clarifications to understand better the concepts. According to both the teachers and VIS, communication during the lesson process is predominantly oral, and if there is sufficient time, the teacher dictates the notes to the students who

take notes in Braille. It was during the class observations that the present study raised the following concerns about the science sessions:

1. The science and mathematics teachers, as well as VIS interviewed seem to jointly agree that they end up failing to write proper content, because it is not easy for them to write some mathematical and other science illustrations or/and drawings. It could as well be deduced from these observations that teachers are not fully updated with all Braille signs, and are therefore, unable to promptly update their students too.
2. The equally established argument among teachers that VIS need more time for their successful learning achievements was interpreted as the teachers' perception of their visually impaired learners as learners with limitations, in comparison to sighted ones, instead of perceiving them as normal children with a different style of learning. In other words, the teachers with a wrong attitude may also teach with misplaced learning outcomes, or using inappropriate didactic tools.
3. The teachers' challenges and limitations are actually reflected in the type of questions that kept emerging during the interviews: *How can a blind student understand the concept of precipitation in a chemical reaction without seeing it concretely? How can a blind student conceptualize the difference between a gelatinous precipitate and a non-gelatinous precipitate without seeing them? How can a blind student conceptualize the change of a color of an acid-base indicator in an acid-base titration without seeing the changes?* To these and a host of other teachers met during the study, it is purportedly clear that there are no practical responses.

In essence, the present research recognizing teachers as the key agents in education, their plights and attitudes indicated in the above assertions, also raise concerns about learning opportunities available for a learner in a classroom where teachers are enormously limited in perceiving alternative innovations. They are usually limited in substituting vision with appropriate auditory and tactile stimuli, as they try to enable VIS in their classrooms to access and explore the learning environment and learn new concepts.

It was observed without surprise that VIS in HVP-Gatagara-Rwamagana generally performed poorly with low grades in Science subjects, compared to their performance in arts and language subjects. For example, the average performance in S.2 of second term 2011 indicated the following records: Chemistry-50%, Physics- 33.3%, Biology- 26.7%, while Kinyarwanda average recorded 87.3%. The teachers' explanations on the performance was that they (teachers) lack adequate training related to the specific educational needs of VIS, and the few and rare workshops organized by the Ministry of Education (MINEDUC) and HVP-Gatagara do not necessarily equip them with sufficient skills in teaching the particular category of learners.

The situation is explained by Dion, Hoffman & Matter (2000: 4) asserting that blind and visually impaired students have a specific learning style that stems from the student's unique perception of the world. For example, if a sighted person enters a room, he/she immediately notices the surrounding: how the tables and chairs are arranged, where there is an empty chair, etc. In gaining all of this information, he/she utilizes very little verbal information and almost no tactual information, to construct a complete understanding of the situation, including the interrelationship of

the different objects in the room. On the other hand, instead of visual information, a blind or visual impaired person would rely on auditory cues, verbal communication, or information gained from moving around the room. By any of these methods they will have difficulty in constructing the entire scene because they do not have information about areas they are not in direct contact with. They seem to agree with Kumar, Ramsamy & Stefanich (2001), who propose that it is critical that teachers need more than ever before to understand students with diverse exceptionalities, their characteristics, their needs, and effective strategies to work with them.

In conclusion, despite the view initially established by the present study that VIS are endowed with the same range of cognitive abilities as sighted students, the equally established reality by the findings is that similar category of students (VIS) in other schools are also subjects of the same schooling conditions, and are equally limited in their learning of Science and Mathematics. This is also the case in all subjects in which tactile representations of graphical illustrations and measurements, symbols and signs, are unknown and/or particularly difficult for teachers, and therefore, almost inaccessible to their blind students.

### *Discussion of the results*

#### *Accommodation of the VIS in mathematics and science lessons*

Though the present paper reiterates the view that with appropriate accommodation in the school, VIS are able to achieve and master all science and math concepts as well as sighted peers of same age and schooling levels (Sahin and Yorek, 2009), the findings discussed above seem to establish the fact that the extent to which educational settings similar to HVP Gatagara can be able to measure up, is solely dependent on the availability and adaptations of educational provisions and services.

In essence, adequacy of adapted resource provisions, learning and teaching environment, as well as the adapted teachers' capacities and other adaptive services geared towards enabling the visually impaired students to participate adequately in schooling, play an important role in determining how much is achieved by the VIS.

Apparently, the key issue being underscored here is "*accommodation*" or "*adaptation*" of key aspects in the teaching and learning processes within the educational systems geared towards facilitating the VIS. Accordingly, the concepts need to be understood in their complete and practical inferences, and therefore, not only its dimension that concern the learning/teaching resources and approaches. They also need to be understood in all other changes required that may include attitudes and mindsets of the school community in particular, the general society towards the abilities and inclusiveness of VIS, the adaptations required within the Rwandan education programs and school curriculums, etc. In other words, to achieve full accommodation and participation of VIS in Rwandan schooling, the following considerations within the educational system appear to be of crucial importance:

Table 2: A range of Assistive technologies that might render learning for VIS more accessible

1. Screen magnifiers.
2. Speech recognition software
3. Text-to-speech (TTS) software
4. Optical character recognition (OCR) software
5. Large monitors
6. Closed circuit television (CCTV)
7. Hand held electronic magnifiers
8. Dictation devices and transcription
9. Scanners
10. Standalone reading machines
11. Fusers and swell paper
12. Braille technology
13. Refreshable Braille displays
14. Braille note takers
15. Braille embossers
16. Braille writers
17. Braille translation software
18. Alternative keyboards
19. Audio description
20. Audio players
21. Digital books



- Educators who are appropriately equipped with relevant skills, motivations and attitudes, e.g. Braille and tactile literacy, Mobility skills, etc.
- Schools adequately equipped with adapted resources, e.g. Tactile and concrete models, maps, Braille materials and software adapted for VIS, etc.
- School general regulations and programs adapted to the educational needs of VIS, e.g. school activity schedules,
- Clear guidelines for classroom and whole school practice, all geared towards the adapted teaching of VIS in special and inclusive educational settings, e.g. approaches of teaching visually impaired learners in special schools, or/and with sighted students, use of assistive devices, etc.

The ideas resonate with advocates of inclusive education (Rieser, 2012; Rouse, 2010; Karangwa, Miles & Lewis, 2010) who continue to advance the view that, the right to education requires examining whether students with disabilities are not excluded from the general education system on the basis of their educational needs, that reasonable accommodation of the pupil's requirements is provided in the general education system, and that enabling measures are provided to maximize academic and social developments. It is actually proposed in the same way that successful education of learners with Visual Impairments does not demand anything more or less than what ordinary learners require, it rather underlines the need to access alternative (as opposed to ordinary) support, to enable their equal participation in all school activities, through adapted services and provisions, that ought to be mainstreamed within the whole school and/or national education systems.

### *Focusing on transformation of the whole school system*

Findings from South Africa (Smith, 2011: 79) across different socio-economic groups, point out that inequalities which are known to exist are largely due to the legacy of the Apartheid system, and argues that policy focus should be wider than just resourcing levels, targeting deprived groups in rural neighborhoods mainly, developing alternative interventions and strategies to overcome some of the acute social disadvantages that pupils, bring with them into school. In the same way, the issue of school adjustment and accommodation raised above also resonates with voices of advocates of education for the Visually Impaired as a shift from perceiving disability as the barrier, to social factors as the disabling problem, that need to be more accommodative and enable the latter to participate as a matter of right (Charlton, 2000, UNESCO, 2005). Though these voices have often been heard from the civil rights group dominated by DPOs, its input into education has increasingly been acknowledged and expounded within the UNESCO's policy tools and guidelines (UNESCO, 2009). It is generally suggested thus that, the educational program that considers effective learning of disabled learners should also be able to restructure and shift the entire system away from:

- Teacher-centered to child-centered pedagogy
- Rigid to flexible teaching and learning approaches
- Competitive to collaborative education system

- Rote learning to discovery learning approaches
- Class focus to whole school focus
- Disempowerment to empowerment of learners
- Normality to diversity of learners
- A fixed state to evolving process of learning and teaching
- Barrier laden to barrier free learning and teaching environment
- A 'can't do' to a 'can do' attitude development among learners

It ought to be admitted here though that, on average, the suggested shifts to accommodate learners with disabilities and other special educational needs still remains alien to many Rwandan education practitioners and planners. The current Education Sector Strategic Plan (ESSP, 2010: 18), recognizes the persistent misunderstanding of Special Needs Education and pledges renewed redress of key aspect of education that include resource provisions, teacher training, flexible curricula and others.

### *Meeting learning needs in poorly-resourced school setting*

Findings in HVP Gatagara–Rwamagana 9YBE School indicate that educators are subjected in a situation of inadequacy of both resources and skills with which to support fully their VIS. The study adds that the inadequacy is actually due to the fact that most of the attention by the educational sector is focused on the many priority demands of ordinary education (ESSP, 2010), and therefore little attention, is left for the education and support of schools and centers for learners with SEN that are largely private and charity supported. In her work, *“Where there are few resources”*, Sue Stubbs, (2002) looks at school improvement for inclusion of learners with SEN in underprivileged communities of the South, and observed that:

*“One aspect of promoting ‘primary education for all’ is getting children into school. However, just getting children into schools is a complete waste of time, energy and resources unless what happens in schools is useful, relevant to the community, effective and appropriate. If it is not, then children will keep dropping out. Unfortunately, large numbers of schools offer a very poor quality of education” (p.15).*

Through a very wide range of resourceful examples cited from experiences in less developed countries however, she confirms that indeed there are quite a number of challenges (p. 35-39), but also locally tailor-made innovative solutions have been proven to work successfully (p.15) as summarized in Figure 5 above. The present study draws a related conclusion for the benefit of schools like HVP- Gatagara, concurring with her that though the school is doing its best with limited resources, achieving in science still demands that educators be more innovative, seeking more indigenously-developed solutions that are affordable and accessible, as the school continues to improve on educational provisions.

### *Educating Rwandan Visually Impaired vis-à-vis national development*

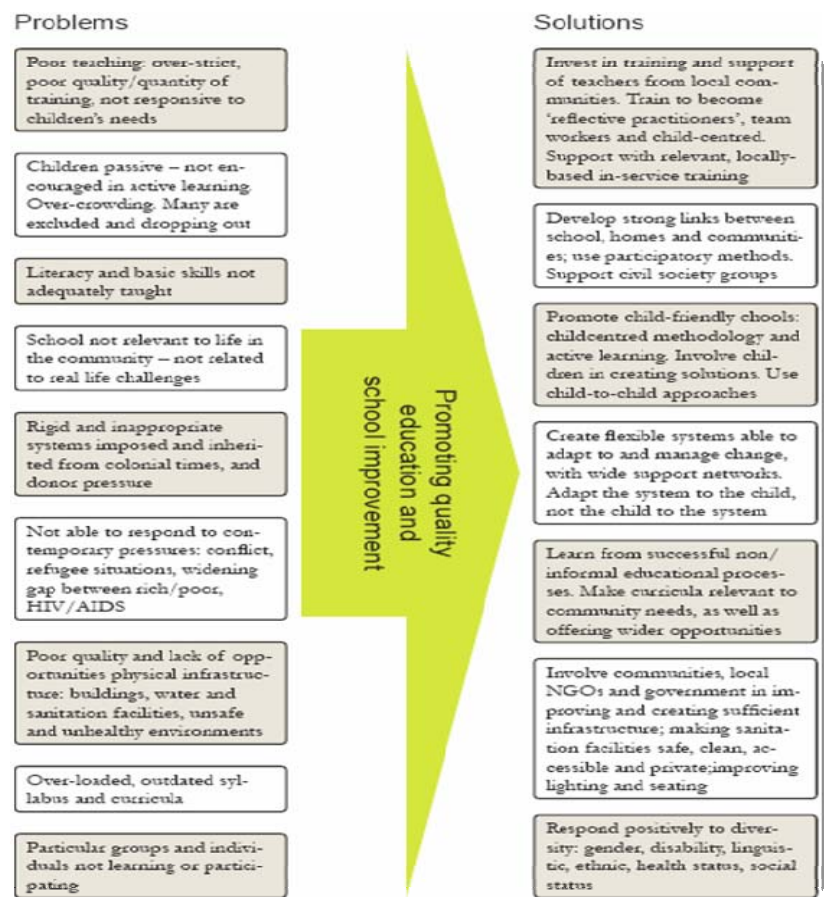
It has often been reaffirmed through documented government strategic plans that for sustainable Economic Development and Poverty Reduction, Rwanda counts primarily on its human capital development, which is heavily

dependent on the knowledge-based Service Sector (Republic of Rwanda, 2007). It is maintained in the national Economic Development and Poverty Reduction Strategy (EDPRS, 2008-2012) for example that:

*“A priority objective of Rwanda’s recent education policy has been to increase secondary school enrolment, so that all children complete nine years of basic education ... This is critical for enabling the country to achieve its goal of becoming a knowledge-based and technology-driven society (p. 22)... In order for Rwanda to achieve the structural economic change implied by the targets of Vision 2020, the country must develop a wide range of skills among the labor force in a relatively short space of time (p. 34).*

Accordingly, the strategy underscores the important view that the program of educating all young Rwandans irrespective of their abilities and disabilities; background or gender, also fittingly complements the country’s economic development plans. In other words, the education initiatives of VIS in HVP – Gatagara and in schools of the same category ought to be considered at the same priority level as ordinary education sector within the national development planning. The present study is however concerned that despite the clearly expressed government commitments, the VIS in Rwandan schools like in many other

Figure 5: Problems and suggested solutions in poorly resourced schools (Stubbs, 2002: 32)



learners with SEN, continue to be marginalized in general education, and particularly in subjects and training related to science and technology. The situation to which they are persistently subjected therefore, not only deprives them of a level field on which to compete with their peers, but also withdraws them from equal participation in economic development. The present study is prompted to affirm with conviction that without alternative educational strategies for this category of learners, Rwandan education sector mission will continue to miss its development targets.

## Conclusion

Taking HVP Gatagara as the field of inquiry, the study attempted to understand the context within which Visually Impaired learners in Rwandan schools are expected to achieve in Science and Mathematics, as a means of

underscoring dimensions of quality and equality in educational services. It also identifies key areas of schooling that affect education of VIS, considering their education as an important contribution to national development (O'Sullivan, 2001; Alexander, 2008; Tikly and Barrett, 2011).

With proven observation through the present study that little consideration is accorded to the support of educating children with Visual Impairments (and other SEN) in Rwandan schools. It also highlights the fact that depending on how disability is measured, awareness about the educational needs and plights of about 12-15% of the world's disabled population is rising worldwide, awakening civil-rights groups to demand what is due as a constitutional right, especially their education as a precursor to their social inclusion (Charlton, 2000). It is thus made evident that it is urgent for Rwanda education sector to consider the key dimensions of education for subsequent inclusion and development of its people with disabilities. These entail education service development such as teacher training and other capacity building programs, as well as adapted provisions and other support facilities for learners with disabilities and other special educational needs.

Given that Rwanda envisions development through an empowered community of its capable people, it is also mandated to adopt education policies that reflect how its children and youths with disabilities' (including VIS) education is effectively implemented, and sustainably supported. It ought thus to entail the demonstration of the government support to services and facilitation, adaptation of the curriculum or its quality insurance, especially with regard to science and technology for all students (including the VIS), as a strategy that guides sustained career development and economic development.

As Rwanda strives to meet the Millennium Development Goals therefore, it is also worthwhile for the country to pay tribute to those who have contributed to the development of education of the marginalized groups such as the Visually Impaired children. The present study finds the foundation laid by Father Joseph Fraipont, a memorable initiative, and a key milestone that Rwandan education and economic planners ought to value for the current and future development strategies.

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