

# Competencies of Students with Visual Impairment in using the White Cane in their Learning Environment: a Case Study at Wenchi Senior High in Ghana

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## ABSTRACT

**Purpose:** *This study investigated the competencies of students with visual impairment at Wenchi Senior High School, Ghana, in familiarising themselves with their learning environment using the cane.*

**Method:** *A case study design was adopted for the study. A mixed method approach was utilized in this study. A quantitative approach was used to assess students' competencies in using the cane while qualitative approach was adopted to probe challenges related to using the cane.*

**Results:** *Students had reached higher stages on the Conscious Competence Matrix and were by and large competent in using the white cane in their learning environment. However, personal and environmental factors were marring their progress. The personal factors included difficulties with fine motor skills and onset of blindness. The external factors were lack of mobility trainers and canes, as well as barriers within the physical environment. There is generally a positive correlation between onset of visual impairment and specific cane skills.*

**Conclusion and Implications:** *It is recommended that resource persons devote more time to developing the competencies of students in cane techniques, especially in skills related to identification of obstacles. Modifying the physical environment, as well as providing more canes and additional mobility trainers, will be useful in facilitating the movement of visually impaired students within the school.*

**Limitations:** *A major limitation is the lack of objective assessment of residual vision and motor impairment. Residual vision likely played a crucial role during the competency test.*

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## INTRODUCTION

There is worldwide concern about restrictions in the movement of persons with visual impairment. Due to poor vision and the likelihood of misinterpreting their relative position in space, they often find it difficult to orient themselves to other people or objects in the environment. Consequently, many persons with visual impairment lack the confidence to move around their environment independently (Crudden et al., 1999).

The white cane is an important assistive device utilized by persons with visual impairment to access their environment. It has many proven benefits, such as improved confidence to travel independently, ease of interactions with the general public and increased safety during travel (Vision Aware, 2016). The cane, as an assistive technology, has had the greatest impact in terms of success in the education and employment of visually impaired persons (Gamble and Dowler-Hirsh, 2004). Thus, it enhances the individual and social life of persons with visual impairment and also promotes their education in inclusive settings (United Nations Economic, Social and Cultural Organisation - UNESCO, 1994). Despite the paucity of research on the number of visually impaired persons who use the white cane, it is generally acknowledged that very few use the white cane for familiarisation with the physical environment (Sah, 2010). Documented reasons for the low usage include difficulty in keeping the cane out of other people's way when not in use, difficulty in stowing it in a car, and an increased risk of being a target for persons who would want to take advantage of the visually impaired (National Federation of the Blind, 1995). In some instances, these challenges have compelled some visually impaired persons to abandon the cane as an assistive technology (Philips and Zhao, 1993).

The ability of students with visual impairment to move about independently in their environment is one of the primary goals in their total educational development, as it enhances their participation in mainstream society (Wong and Cohen, 2008). The cane comes with a handle, shaft and a tip that allows persons with visual impairment to navigate their environment. Primarily, it is used in identifying obstacles, landmarks, cues and clues within the immediate surroundings. To the best of the researchers' knowledge, this is the first study

aimed at measuring the competency of visually impaired persons (students) in the use of the white cane.

Several factors affect competence in the use of the white cane by persons with visual impairment. These can be classified into personal and environmental factors. Personal factors involve the level of training, onset of blindness, fine motor and gross motor skills, as well as choice of length of cane (Miller, 2002). Higher level of training with the white cane, early onset of blindness, and good fine and gross motor skills are likely to enhance effective use of this device. In general, longer canes enhance competence in familiarisation as opposed to shorter ones (National Federation of the Blind, 1995). Environmental factors that influence competency in the use of the white cane include the presence of physical barriers, and may range from the absence of walkways to overcrowded locations (Mettler, 2008).

The cane promotes independent movement for students with visual impairment, especially in a school setting where limited personal assistance is offered (Martinez, 2005). In order to participate fully in academic pursuits, it is essential for such students to be adept in cane usage techniques. The appropriate use of the white cane is therefore crucial to students with visual impairment in familiarising themselves in inclusive education settings (Sah, 2010).

The Conscious Competence Model explains the process and stages of learning a new skill (or behaviour, ability, techniques). It is a useful reminder of the need to learn and train others in stages. The Conscious Competence Learning Model often comes in 4 stages, though occasionally a fifth stage or level is added in more recently adapted versions. The learner or trainee always begins at stage 1 – ‘unconscious incompetence’ - and ends at stage 4 – ‘unconscious competence’, having passed through stage 2 – ‘conscious incompetence’ - and stage 3 – ‘conscious competence’. At stage 1, the trainee is not aware of the skill existence, nature, relevance, deficiency, and benefit offered by the acquisition of the new skill. Stage 4 is the highest level of competence where the trainee has internalised all aspects of the new skill (Pateros, 2016).

## **Objective**

The specific objectives of the study are to assess the competence of students in cane techniques, ascertain if there is a correlation between onset of visual impairment and competency level, as well as establish the challenges associated with the use of the cane for familiarisation within the school.

## METHODS

### Study Design and Approach

A case study design was adopted. A quantitative approach based on the conscious competency model was used to collect information on the competence of participants in the use of the white cane, while a qualitative approach that utilized a semi-structured questionnaire was used for the assessment of challenges involved in cane use.

### Setting

Wenchi Senior High School is located in the town of Wenchi, in the Brong-Ahafo region of Ghana. The school has a total student population of 1,400. It was one of the pilot schools for inclusive education at the senior high level and has sustained the practice over the past 8 years. Visual impairment and mobility impairment are the major forms of disability among students admitted to the school. Various resource persons are employed to assist in the management of students with disabilities. Facilitators provided by the school include white canes, ramps and rest zones with seats.

### Study Population and Sample

The study population consisted of all visually impaired students of Wenchi Senior High School. Major inclusion criterion was that the participant ought to have spent at least a year in school.

Table 1 represents the demographic characteristics of participants. A total of 35 participants completed the study, with nearly two-thirds being males. The vast majority of participants had no upper limb motor impairment. Nearly half of them had residual vision.

**Table 1: Demographic Characteristics of Participants**

Variable	Mean/Frequency (n=35)
Age (mean $\pm$ SD)	16.7 $\pm$ 2.9
<b>Gender</b>	
Male	22 (62.9%)
Female	13 (37.1)

<b>Year Group</b>	
Second	20 (57.1%)
Third	15 (42.9%)
<b>Reported Limb Motor Impairment</b>	
Present	5 (14.28%)
Absent	30 (85.71%)
<b>Residual Vision</b>	
Yes	17 (48.57%)
No	18 (51.43)
<b>Time of Onset of Visual Impairment (Years)</b>	4.1 ± 4.3

### Sampling Technique

A sampling frame consisting of all 60 visually impaired students was constructed. Simple random sampling was used to select 35 participants from the sampling frame. This was done using the Stata syntax “sample 58”. Stata automatically selected 35 participants from the list of 60 by simple random sampling without replacement.

### Data Collection

Data collection, using participant observation on a test and a semi-structured questionnaire, was done within the school premises. The Competency test scoring was done by the researchers concurrently as a student performed a specific test. Competency was measured by observing the positioning of the white cane relative to the floor, ability to swing the cane on a test trip to the school dispensary, and ability to identify obstacles with the cane. Positioning of the cane was scored based on efficient grip, angle of orientation of cane relative to the participant’s body, and the angle of orientation of cane relative to the ground. Ability to identify obstacles was scored based on time spent to identify the obstacle as well as an accurate determination of the obstacle. Cane swinging in this context refers to the ability to move the cane to the alternative side (right or left) when a particular leg (right or left) is in the mid-stance phase of walking. It was scored based on the angle of sweep to the alternative side and coordination relative to the body. Scoring of competency on the Conscious Competence Matrix for each student was done simultaneously by three researchers, to ensure consistency.

A semi-structured questionnaire was administered to the students to assess challenges related to the use of the white cane within the school. Questions focused on the nature of the school environment, the nature and number of available canes, motor skills of students and the number of resource personnel in the school. All participants were subjected to the competency test and completed the semi-structured questionnaire as well.

Validity of the questionnaire was ensured by paraphrasing questions to be consistent with research objectives. Ensuring validity of the practical test involved repeated scoring of the same participant by different researchers.

### **Data Analysis**

Data was analysed using Stata version 12. Continuous numeric variable was summarised using mean and standard deviation. Categorical variables were summarised by frequency counts and percentages. Spearman's rank correlation analysis was used for the test of correlation between onset of blindness and competency scores (positioning of cane, ability to swing cane, ability to identify obstacles). Scores of 80% and above, 70% - 79%, 60% - 69%, 50% - 59%, 45% - 49%, 39% and below, correspond to stages 4 - 1 respectively on the aforementioned Matrix. Open-ended questions from the semi-structured questionnaire were analysed based on thematic content that utilised colour codes.

### **Ethical Considerations**

Ethical approval was sought from the Committee on Human Research, Publications and Ethics, Kwame Nkrumah University of Science and Technology, School of Medical Sciences. Respondents signed an informed consent form before enrolling in the study.

## **RESULTS**

### **Components of Cane Technique Competencies and their Scores**

#### **Positioning of the Cane**

Table 2 presents the ranking of students on positioning of the cane. Majority of the students (60%) were able to position the white cane 'excellently' from the starting point. Based on their performance in line with the Conscious Competence Matrix,

these students were judged as having attained 'unconscious competence', and are thus at stage 4 within the Conscious Competence Matrix. One-fifth of the participants scored 'very good'. This group had attained 'conscious competence' with positioning of the white cane. In addition, one-fifth of all participants scored either 'good' or 'average'; they were deemed as 'consciously incompetent' and 'unconsciously incompetent' respectively.

**Table 2: Ranking of Students on Positioning of the Cane**

Ranking	Frequency (n=35)	Percentage (%)
Excellent	21	60.0
Very good	7	20.0
Good	5	14.3
Average	2	5.7
<b>Total</b>	<b>35</b>	<b>100</b>

Table 3 below indicates that there is a positive correlation between onset of blindness and competence in positioning the cane. The associated P-value indicates that the association between the two variables is statistically significant.

**Table 3: Correlation between the Onset of Visual Impairment and Scores related to Positioning of Cane**

Number of observations (n)	35
Spearman's rank correlation co-efficient	0.57
P-value	0.00

### **Ability to Swing the Cane on a Test Trip to the Dispensary**

Table 4 represents the ranking of the students in swinging the cane on a test trip to the school dispensary, using the correct techniques. The scores indicated that less than half of the participants were able to swing the cane 'excellently' using the correct techniques; they were therefore perceived to have reached the 'unconscious competence' stage. Less than 20% of participants scored 'good' or 'average'; they were deemed as 'consciously incompetent' and 'unconsciously incompetent' respectively.

**Table 4: Ranking of Students on Ability to Swing the Cane**

Ranking	Frequency (n=35)	Percentage (%)
Excellent	16	45.7
Very good	13	37.1
Good	4	11.4
Average	2	5.7
<b>Total</b>	<b>35</b>	<b>100</b>

Table 5 below indicates there is a positive correlation between onset of blindness and competence in cane swinging. The associated P-value indicates the association between the two variables is statistically significant.

**Table 5: Correlation between Onset of Visual Impairment and Scores related to Swinging of the Cane**

Number of observations (n)	35
Spearman's rank correlation co-efficient	0.69
P-value	0.00

### Identification of Obstacles

On competence in identifying obstacles, only 11.4 % of the students scored 'excellent'. Over a quarter of the participants scored 'very poor'; they were perceived as 'unconsciously incompetent'. Less than 30% of all participants scored either 'very good' or 'good'.

**Table 6: Ranking of Students on Ability to Identify Obstacles with Cane**

Ranking	Frequency (n=35)	Percentage (%)
Excellent	4	11.4
Very good	6	17.1
Good	8	22.9
Average	5	14.3
Poor	3	8.6
Very poor	9	25.7
<b>Total</b>	<b>35</b>	<b>100</b>



There is a strong positive association between onset of blindness and scores related to identification of obstacles by participants. The associated P-value indicates the aforementioned association is not due to chance (see Table 7).

**Table 7: Spearman’s Rank Correlation between Onset of Visual Impairment and Scores related to Identification of Obstacles**

Number of observations (n)	35
Spearman’s rank correlation co-efficient	0.7026
P-value	0.00

### **Challenges in the Use of the White Cane**

A number of challenges conspiring against the students’ effective use of the cane were identified. These challenges have been categorised under 6 broad thematic areas: the unfriendly nature of the school environment, nature of the canes, inadequate canes, poor motor skills, and inadequate resource personnel.

#### **Unfriendly School Environment**

The students asserted that due to the absence of landmarks they found it difficult to identify their starting point, that is, their exact point of location at a particular time, and how to get to their designated destination. Furthermore, participants bemoaned the fact that there were no handrails to give extra stability when using the cane to negotiate staircases. They were equally frustrated about the nature of some of the roads. For example, the road leading from the boys’ dormitory to the resource room was not tarred, and this made it extremely difficult to use the cane.

#### **Nature of the Canes**

Challenges related to the nature of the canes included canes not being collapsible and being fragile. Some of the students indicated that because the canes were not collapsible, they found it difficult to fold them when entering their classrooms. A related challenge raised by the participants was that the fragile nature of the canes resulted in frequent breakages. Additionally, the handles of some of the canes were so worn out that they sometimes hurt the palms of the users. Most students admitted these challenges discouraged them from using the white cane on a regular basis and subsequently impacted their competence negatively.

### **Inadequate Number of Canes**

Another major challenge was the inadequate number of canes in the school. At the time of the study, there were only 18 canes for 60 visually impaired students in the school.

### **Lack of Fine Motor Skills**

Some respondents had difficulty in executing cane techniques due to a lack of fine motor skills. This made them clumsy in using the cane. Fine motor skills refer to the ability to undertake movements that involve small muscle groups such as using the fingers to grip (Kid Sense, 2016).

### **Inadequate Resource Persons**

There were just 4 resource persons responsible for training and assisting 60 visually impaired students. In addition to assisting visually impaired students, the resource persons had other duties which made them rarely available to train the students.

### **Strategies to Address Challenges**

A number of strategies have been adopted by the resource persons in the school to eliminate the challenges that affect students' competence in the use of the cane.

The first strategy involved regular training in the morning, supervised by the resource persons, to enhance students' competence in the use of the cane in terms of handling and positioning. A second strategy was aimed at addressing challenges associated with identifying obstacles within their learning environment. This involved identification of obstacles within a specific area of the learning environment and familiarising students with the location of these obstacles. The resource persons changed the site of this activity once students had become familiar with a particular area of the learning environment.

## **DISCUSSION**

Assistive technology is an expansive term that encompasses both assistive technology devices and assistive technology services (Alper and Rahrinna, 2006). Specifically, an assistive technology device refers to any equipment or product system that may be customised or acquired off-the-shelf and used to maintain or improve the functional capabilities of persons with disabilities (Sah, 2013). The

white cane is an essential assistive technology device which allows for independent travel by the visually impaired (Vision Aware, 2016). The ability of students with visual impairment to move about independently in their environment is one of the primary goals in their total educational development (Wong and Cohen, 2008) and the white cane is undoubtedly crucial for this function.

If students with visual impairment are able to exercise control over their movement, it will lead to greater independence, increase their self-sufficiency as well as enhance their self-esteem (Smith, 2008). This will increase their participation in school activities and, subsequently, enhance their academic performances. Thus the findings indicating that students were competent in the use of the white cane in terms of positioning and swinging ability, suggest that many of these students are likely to have some level of autonomy in movement which will enhance their inclusion and participation in school activities. This deduction is consistent with the assertion of Vision Aware (2016) that cane positioning and swinging ability were vital for independent ambulation by the visually impaired. However, this autonomy in movement is threatened by the fact that most students could not accurately use the white cane to identify obstacles in their environment. This inability implies they were prone to bumping into obstacles or tripping, with the possibility of sustaining physical injuries that could interrupt their academic work, or more importantly, endanger their health. A primary reason for this could be the insufficient number of canes in the school. Each student was able to practice identifying obstacles with the cane only because they took turns during the training exercise. However, as the findings indicated, there are few canes compared to the number of students in the school. Consequently some students are unlikely to get the opportunity to practice identification of obstacles with the cane in real campus situations. The lack of landmarks within the school premises is a likely contributor to the difficulties associated with identifying obstacles, as landmarks often give a clearer indication of where to navigate. Fine motor skills enhance an individual's ability to initiate and maintain a good grip which is essential in using the white cane (Miller, 2002). Visually impaired students without these skills are likely to have difficulties using the white cane. Although motor impairments of students could contribute to poor performance in the identification of obstacles, the condition is not widespread enough to affect most students as just about 14% of them reported motor impairment. A related factor is how consistently orientation and mobility skills are taught in the school. The few resource personnel in the school may be unable to provide adequate orientation and mobility lessons for the students. This may be compounded by

the limited time available for the training, and the tendency to focus more on academic activities.

The varied performances of the students relative to positioning and swinging of the white cane reaffirms that it should not be presumed that all students have learned basic orientation and mobility skills. Mobility and orientation skills for the visually impaired students are often incorporated in the academic curriculum, starting from the basic school level in inclusive education settings. Thus there is a strong tendency for educators and resource persons at the higher educational level (senior high level, in this case) to presume that students have mastered the aforementioned skills.

The positive correlation between onset of visual impairment versus scores related to positioning, swinging, and ability to identify obstacles with the white cane, is an indication that students who acquired visual impairment later in life were generally more competent in using the cane than students who acquired visual impairment at an earlier stage. This is unexpected as students with earlier visual impairment are expected to have better adaptation to assistive devices compared to those who acquire visual impairment at a later stage (Kotain and Sharma, 1999). A possible reason for this could be the presence of residual vision among those who acquired visual impairment at a later stage. Residual vision is likely to enhance grip, angle of orientation of cane relative to the body as well as orientation relative to the ground, upon which cane positioning was scored. An alternative explanation could be the fact that students with previous vision were likely to have better perceived objects and situations related to positioning of the cane, relative to students with congenital blindness. Thus they retain these experiences in spite of their present visual impairment, giving them an added advantage over students who had congenital blindness, in terms of positioning of the cane.

The lack of universal design in the physical environment of the school implies that students are likely to encounter challenges in the use of the white cane. Universal design allows for the presence of facilitators within the environment as well as reduction of obstacles that are likely to impede the movement of visually impaired students. Students unable to overcome this challenge are likely to depend on sighted students for mobility on campus. This dependence has repercussions. Such students are likely to be stranded on the days that their guides do not show up, hampering their academic endeavours.

The fact that canes are not collapsible implies that students were likely to encounter difficulties in areas with restricted space. Long, projecting canes could pose a nuisance in crowded student areas such as the dining hall, assembly ground and, most importantly, the classroom. Thus the long-term effect is that students are likely to abandon the cane when attending school gatherings, subsequently hampering their movement. This corroborates the assertion of Phillips and Zhou (1993) that a change in need or priorities of persons with disabilities could lead to the abandonment of an assistive device. While the non-collapsible canes would have posed few problems in a home setting, the opposite is the case in a school setting.

Fragile canes and worn-out handles have the potential to cause physical injury to visually impaired students. Such incidents may discourage students from using the canes, leading to a loss of independence in mobility and its attendant deleterious consequences. These issues are further compounded by the absence of sufficient number of canes, which suggest there is a lot more pressure on the few available. Consequently, a vicious cycle sets in, where more canes are likely to wear out, making an already bad situation worse.

Overall, the strategies adopted by the school to enhance the use of the white cane are likely to have a positive effect in the longer term. Regular training regimens to improve students' skills in identifying obstacles within the learning environment are likely to enhance their use of the white cane.

Wenchi Senior High School is one of the three senior high schools in the country that currently practice inclusive education. The challenges discussed earlier are inherently associated with inclusive education in Ghana. Thus, despite the numerous policies brought forth to promote inclusive education, significant challenges remain to be overcome if inclusive education is to succeed.

## CONCLUSION

Higher competencies were observed in terms of cane positioning skills and ability to swing the cane. However, in terms of identification of obstacles in the learning environment, majority of the students were either 'consciously' competent or incompetent as per the scores based on the Conscious Competence Matrix. The positive correlation between onset of visual impairment and the various competencies measured is likely attributable to the presence of residual vision in some students. Challenges militating against students' competence in cane techniques in the school cut across personal and external factors.

## Implications

Findings from the study have implications for inclusive education that is currently being implemented in Ghana. The findings revealed some of the challenges students with visual impairment encounter when using an important assistive technology in an inclusive setting. These findings point to the need for adequate preparation in terms of provision of resources, both human and material, redesigning the built environment to make it suitable for all students, and training students to master the use of the assistive technologies they need in order to fully participate in the inclusive education setting.

In the case of the school compound, it is recommended that there should be well-demarcated areas to ensure that positions of obstacles are more predictable. This will likely enhance students' ability to identify obstacles. Further to this, a school environment with incorporated universal design will ensure the presence of facilitators such as handrails that would make it easier to use the cane.

It is suggested that more practice time be allocated to enable students to familiarise themselves with the school's environment. Further to this, the training approach with regard to the identification of obstacles needs to be re-examined. For example, assigning resource persons to handle specific training regimens related to identification of obstacles will yield better results in all likelihood.

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