

CHALLENGES LEFT-HANDED STUDENTS FACE IN KENYAN GIRLS' SECONDARY SCHOOL SCIENCE LABORATORIES

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ABSTRACT

Previous research on left-handedness has mainly taken place in developed countries. This study aimed at investigating the challenges left-handed students faced in secondary school laboratories and how well they coped with the challenges in Kenya. It also sought to find out whether teachers were aware of the challenges and what help if any they gave the students. The participants were five left-handed science students and their respective subject teachers from a girls' school in Kenya. The students were enrolled in practical subjects: Chemistry, Biology, Physics, Computer studies and Home science. Qualitative data was collected through classroom observations, individual and group discussions. Data revealed that left-handed students experienced challenges generally in school and specifically during practical work. These challenges resulted mainly from having to write left-to right (handwriting), unfavorable sitting positions in uncomfortable desks, handling and manipulating of some apparatus during practical work among others. These challenges posed many disadvantages to the students as they reported inability to finish timed tasks. Majority of the teachers were aware of the students' challenges but gave insufficient help. The school had nothing in place for the left-handed students, a confirmation that like in many parts of the world, left-handedness has never been considered a special learning need in our context. The conclusion of this study provides evidence that there is need for Kenya government to rethink her initial and in-service special education needs' teacher training to include a module in left-handedness in order to equip all teachers to be able to identify and assist left-handed students to learn with least difficulty. The researcher suggested that left-handed learners like other mild special needs learners be added more time during timed tasks especially the practical papers in KCSE examinations. [AJCE 4(3), Special Issue, May 2014]

INTRODUCTION

In the Kenyan context like in many parts of the world, the secondary school science curriculum involves an inclusion of hands-on activities that authenticate and endorse scientific claims through the collection of scientific data, analysis and make inferences. Students need to verify that $E=mc^2$ or determine whether photosynthesis actually takes place in the dark thereby living through science at first hand and build stock of personal experiences [1].

According to Tan [2] the benefits of the science laboratory have earned it a central and well defined position in science education. However, unless the learners are able to interact with the apparatus fluidly, what goes on in the laboratory may either contribute little to their learning science or does not engage them in doing any meaningful science [3]. Consequently, laboratory experiences can be very annoying if students for whatever reason are unable to interact with the available apparatus successfully as it can lead to tensions in the laboratory [2]. On the other hand, when students struggle with apparatus and fail to observe, measure and record accurately, this experience of 'failure' can lower their self-esteem and self confidence.

In Kenya, the teaching of science requires that learners choose all or two of the sciences offered and examined by the Kenya National Examinations Council (KNEC) at the end of form two. At the end of form four, all students are assessed in individual undertakings in the laboratory in the enrolled science subject. In order to tally 9 points on a 12 point scale and meet the requirements of the Kenyan universities Joint Admissions Board (JAB), a student must have scored at least 30% in the practical component of the subject. Failure to meet the minimum requirement means that a student may not join certain jobs and talent is lost.

Some of the reasons that may make a student not meet the requirements may be the presence of a learning disability which may also present a barrier to learning at the same speed as

his/her peers or worse still the inability to complete timed tasks. Failure to complete timed tasks may not necessarily mean deficient in content knowledge but may include factors intrinsic to the individual [4]. This may be the case of the left-handed learners.

Left-handed learners due to their affiliations have poor motor skills and are clumsy [5]. This has been explained in part to be due to their use of right handed instructional resources. In effect, this use leads to reduced learner outputs which also lead to a negative attitude towards the subject and an eventual withdrawal from active participation in the learning.

Statement of the problem

In situations where the majority of the students and probably the teacher are right handed, the presence of a left-handed student may go unappreciated. They are subjected to the use of instructional resources that are not suited to their grasp. It is the use of these right handed instructional materials that cause challenges to left-handed learners as it makes it difficult for them to cope with these challenges especially when carrying out hands-on activities.

Left-handedness has never been recognized as a special learning need the world over. Therefore, initial teacher training colleges do not prepare teachers to adequately deal with left-handedness. Most teachers are not aware of these challenges and therefore do not offer any help to assist the learners cope yet this affects the learners' gains and attitudes against the subject.

LITERATURE REVIEW

Background to left-handedness: Studies show that left-handers are approximately between 10% and 13% of the world population. Men are more likely to be left-handed (12.6%)

compared to women (9.9%). Young people are more likely to be left handed (14% for men and 12% for women) than the elderly (nearly 6% for both sexes) [6].

Despite their presence in our midst and a large percentage of them in our classrooms, the left-handed are discriminated against in nearly all aspects of their lives; from religion to languages and the everyday tools. The Christian Bible, the Islamic Koran, the Jewish mystical books (Zohar and Talmud) are all in favor of the right hand. All blessings and just decisions are made with the right hand while damnations and deceit arise from the left hand. In Christianity, everyday preferences fortify the positive facet of the right and the right hand. The bible, in particular indicates that Jesus sits at the right hand of God and is in fact God's right hand. Christianity has had wide spread effect on millions of the world population through history and therefore potentially strengthens the spread of the right hand preference.

The long history of language has not spared the left handed either. The major languages of the world have ego deflating figures of speech [7] for left-handedness. For example, in French: '*gauche*' awkward, clumsy; Danish: '*keijthandet*' cat handed; Italians: '*mancini*' crooked, maimed; Germans: '*linkisch*' awkward; Russians: '*na levo*' sneaky; Portuguese: '*canhoto*' weak, mischievous; Spanish: '*zurdo*' malicious and Romanians: '*bongo*' crooked, evil [8]. The Swahili refer to the left-handed as '*mashoto*', to mean abnormal.

Left-handed people therefore grow up in a world that has been taught from near infancy that being left handed is bad and this may be passed on till formal school starts. Left handedness is part of a person's make up and not an inclination than can easily be wished away or down played. Handedness is determined by the brain and not the hand that and the most flexible hand is the one that helps the brain and the hand to work together for language and writing. Therefore, forcing a left-handed child to perform a task with the right-hand means they are using the weaker

and less coordinated hand which eventually makes them clumsy, ineffective and easily wearing out [9]. This practice has also been known to induce dyslexia, stuttering and other forms of motor difficulties in children not to mention terrible frustrations and hatred for school and school work [10] and eventually become introverted [9] and fail to make healthy relationships with their peers as would be expected of a developmental stage in child growth. The experience of speech difficulties may also hinder children from articulating their responses in class yet a lot of learning takes place when children are able to express their thinking not only through paper and pencil but also through speech [11].

Challenges faced by the left-handed

Handwriting: Writing left-to right is a complex activity for the left handed children. They write slowly due to poor pen and paper control which causes them to tire easily [5, 9]. Sometimes they may need to lift up their arm more often to see their work and therefore they may need a longer time to complete timed work.

Technology: this is another area of development that has inaudibly disregarded the left-handed. The majority of tools in any technological society are designed for the right-handed and therefore have inbuilt pro for the right-handed over the left-handed [12]. When the left handed are presented with such intrinsically prejudiced tools, they normally have two options; either learn to use the tool right handed (awkward and inefficient at best) or learn to somehow hold the tool backwards so that it can be manipulated with the left hand (often clumsy).

Home science: the apparatus in the home science laboratory require the students to perform tasks using right handed apparatus which require a left-to-right wrist turning movements. For example, a right handed pair of scissors as used in home management practical

lessons has its cutting blades arranged such that the line being cut along can be seen by the right handed users. When used by the left handed users who rely on the left hand for cutting, the aspect of hand-eye coordination impairment interrupts since they cannot see the cutting line. Extensive use of this apparatus by the left handed leads to varying levels of discomfort.

Handling of apparatus during practical work: multi-tasking is a common practice in science laboratories and requires the students to use apparatus with the right hand supported by the left hand. Faced with these apparatus the left handed try to get a comfortable working position which usually entails moving the apparatus. The shifting so involved may alter the order of arrangement and probably cause a mix up. Using the less coordinated hand to perform the activities involves flexing the muscles of the weaker hand and this adaptation takes considerable time for the students which may obstruct precision expected of the task [5]. Rulers which many mathematics and science teachers do not realize are right hand biased are also other apparatus that front challenges to the left-handed users [12]. The numbers on a ruler (as left-handers see it) are on top and read from left to right. Many a times they may use the wrong scale when taking readings and measurements and this can be a source of inaccuracy and disappointments.

Shared work stations in schools: sharing work stations and notably so during computer lessons, a computer mouse on the right hand side of the computer is quite difficult to use and may at best reduce them to spectators. Even when they get to use the mouse, the keys are made for the comfortable use by right handers. Logitech has in recent times developed a computer mouse convenient for the left handed user [13].

Evidently, left-handers' lives are full of challenges and they are obliged to face more than their share of difficulties [14]. More often than not, right handers do not comprehend the accommodations the left handers have to make in order to fit in a world made from up down by

right handers for the right handers [8]. These accommodations include everything from tying shoes, opening doors, using can openers, calculators, using clocks and watches that wind and move in the wrong direction as well as striking a match to more complex processes like writing left to right alphabets [14]. They often face subtle humiliation, prejudice and discrimination from the predominantly right-handed society. It is this discrimination that can sometimes make students lose buoyancy in themselves and their studies.

Left handedness and the left-handed seem to have drawn very little attention in the African context. This has been explained as due to the in-built level of tolerance of their condition and the assimilation with the society that it draws such little consideration today [10]. Schools appear to have failed to understand and support left-handers educational needs [15]. In so doing, they have deprived them a chance to be what they can be. This anomaly can be traced to the failure of initial teacher training colleges to train teachers on how to handle left-handed learners.

It is rather obvious that there is much diversity in the classroom. However, the focus of this research was to investigate the challenges the left-handed children faced while engaging in practical work in school science laboratories and the home science room whose settings are right hand biased and how well they coped with those challenges. It also sought to find out whether teachers were aware of the challenges and what help they gave the students. The main task was to unearth the emotional content and meaning expressed in the everyday occurrences of this special group of learners. This is a research that was inspired by the need to tell the story of learners whose voices have for a long time been ignored and/or silenced in our schools.

METHODOLOGY

In order to understand the challenges and the underpinnings of left-handedness in secondary school science laboratories, a descriptive and exploratory survey research design was adopted for this study. Data was collected through unstructured classroom observations, one-on-one teachers and students' interviews followed by focus group discussions with the left-handed students.

Three lessons for the study were conducted each for biology, chemistry and physics in the respective laboratories and one in the home science room. All the lessons were planned experiments based on previous term's examination. The materials for common sharing were made available from the teacher's bench.

An observation schedule was used to collect the data in the students natural setting [16] in order to take detailed summaries of events and incidents as they occurred in the laboratory [17]. After the left-handed students were identified by the subject teachers, the researcher carried out a non-participant whole class observation but the focus was the left handed students. Aspects like sitting positions, the students level of participation and interaction with the availed apparatus compared to the right handed and any outstanding issues requiring teacher intervention were observed.

Face-to-face interview was also carried out with the left handed students to ascertain and validate the observed data. The discussions involved probing for elaboration and clarification of observations [18] and therefore access more information. The discussions were audio recorded, helping the researcher to develop a free and easy conversational relationship with the interviewees while the open-ended semi-structured questions helped in keeping the interview in track [17]. Items on cultural attitudes, handwriting, and effectiveness of schools meeting the

students' needs, laboratory and practical experiences and questions that sought to find out the overall quality of life in the school were included. The teachers' interview guides sought to establish teachers' awareness of the challenges the students faced in the science classrooms and the help they offered while the principal's informal interview sought to find out what the school had in place for the left-handed learners.

The focus group discussions were done last and they helped the students to stimulate each others' thinking [19] and bringing to the fore issues they may have overlooked during the face to face interviews, or did not feel comfortable talking about them during the face-to-face interview. The researcher was keen on looking out for dominance and conflicts within the group.

Question	Data Collection Method	Data Collection Tool
What challenges do left-handed students experience as they carry out practical work in the laboratories?	Observations (observation schedule, field notes) Interviews (audio records, field notes)	Observation schedule Semi-structured interview guides
Are teachers aware of the problems faced by left-handed students in carrying out practical work and how do they help them cope?	Observations (observation schedule, field notes) Interviews (audio records, field notes)	Observation schedule Semi-structured interview guides
What does the school have in place to help meet the unique needs of left-handed students?	Observations (filed notes) Informal teacher interview (field notes)	Unstructured observation Unstructured interview

Sample and sampling procedures

The school was convenience sampled due to its large population, accessibility and endowment in terms of infrastructure and students and teachers drawn from across the country.

A large student body meant a relatively large number of left-handed students from several ethnic communities. The students were all left-handed girls in their last year of high school and enrolled in Chemistry, Physics, Biology, Home Science or Computer Studies. The students and their teachers were purposively sampled.

Approaches to data analysis

Data transcription and analysis commenced right at the start of the study. Emerging themes from the data were coded to avoid being swamped [20] by the data. All the data was separated into files; student interviews, teacher interviews and classroom observations to provide building blocks for further reflection [19]. The researcher initial thoughts were inserted against each ‘interesting’ aspect in different fonts. Teacher awareness and how they helped left-handed students cope with the challenges were combined and responded to as “teacher awareness”.

FINDINGS

Under this section, the researcher presented the findings on challenges left-handed student participants (coded S1, S2, S3, S4 and S5) faced as gathered from the classroom observations L.Obs (coded L1, L2, L3, L4 and L5) and the face-to-face interviews (S.Int) with the participants. Teacher interviews (T.Int) for participant teachers T1, T2 and T3 and teacher talk (T.talk) for participating teachers T4 and T5 are also discussed.

Classroom observations and student interviews

These views are presented under; cultural attitudes, handwriting, sitting arrangements, shared work stations and multitasking in science laboratories including the home science room.

Cultural attitudes

The following is a response by S5 on whether she had been discouraged from using her left hand:

Yes... I was discouraged from using my left hand. For example when I was a small child, I was beaten up quite many times to ... they [parents] tried to beat me up to stop me from writing using my left hand ... using it for other things and even when writing with it ... my mother, it's my mum eh ... I think according to them they think it's ... the ...what's the norm ... according then, they thought what is normal is to use the right hand. They took me to a doctor, they even thought I had eh ... I had a problem but the doctor told them it was okay for me to keep using my left hand. ... I don't know, I take it they were ignorant then. ... my relatives, they, they find it weird [to be left handed]. I don't know if it is positive or negative. It's like they flinch at the thought of being left-handed themselves. I think ... I think they think being left handed is a bad omen. I don't know why. (S.Int)

Form this response, the parents and relatives of S5 did not hide the fact that they thought their daughter was not normal. For this reason, they sought the services of a doctor in order to cure their daughter. Forcing her to use the hand she was not comfortable with may have caused her mild stutter as she tended to repeat the first words of her statements. According to T3, S5 was not very enthusiastic about verbalizing her responses in class.

S2 also gave her opinion on the ability of left handed students to perform physical duties. She said,

... especially cutting something even at home you are trying to cook something [pause] when am at home they [parents] will think you will pour it, [pause] cutting something They tell me to be more careful or they come and do it for me. I feel kinda [kind of] low coz [because] may be they will say that if you go and do this [pause] may be you will be told you can't do it so you are never sure whether you are supposed to do or you just leave it. Sometimes I do it, yeah, to see if it will work out, yeah, I do it to prove to them that I can do it... (S.Int)

The two opinions highlight parental and community negative cultural attitudes towards left handedness.

Handwriting

All five participants wrote with their left hand. S1, S3 and S4 wrote quite fast, had large handwriting that was both legible and neat. S2 and S5 wrote slowly, S2 in order to make the handwriting legible even to herself and S5 because fast writing made her smudge her work. S1 and S2 smudged their work too. S5 tended to rub and cancel her work a lot because she felt her letters were not curved the right way. This made her work both untidy and messy. S2 said that “when teacher is dictating notes sometimes my desk mate can help me with her book and write down or read out ... where have not heard” (S.Int). This depicts relying on peers for help when trying to cope with the teachers speed and more so during note taking in class.

Sitting arrangements/positions

All five students said they preferred sitting on the left hand side of the classroom, next to the wall or the left hand side hedge of the laboratory. This was to avoid the ‘irritating habit’ (S1) of knocking elbows with those seated on the participants’ left hand side. In instances when the preferred sitting position was not available, the participants had to move so as to create ample space for themselves and others otherwise they bore the discomfort thereof. According to S5,

... in class I make sure I'd sit next to the wall where my left hand will be away from my desk mate... [on] the left side. ... In class, eh ... my desk mate we exchange sides with her. She, she allowed me to go to the other side to sit in a place where I will be comfortable ... but in the dining hall I do not like sitting with my friends in the table because eh, ... eating with my left and they are using their right so I tend to be uncomfortable so I stand most of the time, most of the times I move away ... I feel like am compelled to be the one to move ... [and] that way I do not get to be on the wrong side with anyone. (S.int)

While S1 said that she felt ‘irritated’ that she could not do what others were doing so effortlessly, S2 said “ sometimes it is like you cannot sit where everybody is, yeah, ... and it

makes one uncomfortable and you cannot stay ... normal like the rest ...” (S.Int). This statement from S2 came as a result of having been made to move from her desk by her primary school teacher with no reasons given for the action.

Shared work stations

Seemingly, the participants were comfortable sharing work stations as long as there was enough space for everybody. It however emerged that they had to squeeze, turn and position themselves in order to fit in the provided space so as to participate in class activities comfortably. Since individual laboratory practical arrangements are done facing the front of the room and are mainly placed on the right hand side of the individual, participants said they preferred working across facing the back of the room. That consequently meant shifting the apparatus to that location, or moving the apparatus from the right hand side to the left hand side when the most preferred option was unattainable. According to S4, “...going to the other side would be easier but ... I prefer staying where I am so that they [teachers and other students] don't say that I cheat [in examinations]. That makes me feel like it is unfair” (S.Int).

Handling of apparatus during practical work

Participants claimed that the arrangement of apparatus posed challenges because they had to shift the provided apparatus or adjust them to suit their sitting and manipulation preferences. The challenges faced in the individual subjects are discussed in the following sub-section.

Home science

S1, the only participant enrolled in home science said she found using of a pair of scissors, the tracing wheel, kitchen knives, can openers and a match box particularly challenging for her. Activities such as ironing, cutting, hand sewing and machine stitching were equally challenging to her. This was because she was unable to stitch a long straight lines however much she tried.

I have this problem of straight lines, I really can't ... I always draw crooked so also when I trace down with the tracing wheel it always comes out crooked. I don't know why. But it just happens. ... and the issue of always turning ... the whole body, ... uh, it's tiring! If am stitching I feel that it will not be straight. It just does not come out straight even when am using the machine sometimes I have to redo and redo I actually manage to finish my work but the teacher is always complaining, straight lines, straight lines! (S.Int)

Ironing also took a lot of the participant's time. This was because she had to first put the iron down to straighten the garment with the left hand as well as position herself in a way as to comfortably iron the garment. She tended to also hold the garment very close to her face during stitching. She reported that this was to allow her to see the stitching line clearly.

Chemistry

All five participants were enrolled in Chemistry. However, only S1 and S2 were observed. During lesson observation L2 taught by T3, S1 took the reagents provided for her group (the students were put into groups of four) to transfer to another container, she poured out some of it. After collecting more reagents from the distribution table she failed to stop the watch on time. Left with no more reagents for the group to carry out further investigations the group members redistributed themselves among other groups because the teacher had made it clear that

all groups had only one chance to change reagents (L.Obs) during the interview, S1 had this to say;

... titration could be a challenge for me because my right hand is weak and not able to control the tap [on the right hand side of the burette] with my left hand and stop a watch with my right hand at the same time ... I pressed my finger [to stop the stop-watch] and it slipped so I did it again and time had elapsed since the end of the reaction. I don't know whether they [group members] were annoyed but [sighs] what could I have done, I did not do it on purpose! (S.Int)

S4 said that during titration “I swirl the flask with my right hand and stop the watch with my left hand. The burette tap is usually on the right hand side so I have to position myself to work on it” (S.Int).

Although S2 was able to coordinate her hands, she reported that;

In titration I have to use this hand [shows the right hand] to shake the ... may be contents and you feel as if you are not doing it right and you keep on shaking I feel like one hand is heavier than the other and sometimes swirl too hard and end up pouring the flask contents (S.Int)

In the overall, it appeared that the failure to meet requirements of the task made the students frustrated and the lose confidence in themselves.

Biology

All students were enrolled in Biology but only S5 was observed in this study. During the lesson [L5] the students were required to draw a rib as drawn by the teacher [T3] on the chalkboard. In the case of the curve of the rib was facing the student's right hand side. S5 was observed doing two diagrams, one facing the right and the other facing the left. The one facing left was later rubbed. For the other facing the right, the direction of the motion of strokes was opposite that of the teacher and the rest of the class (L.Obs). During the interview, S5 said, “I

tend to change the directions in my drawings ... yeah; you can say that I rub a lot too". S2 rubbed a lot too as she said during the interview.

The two participants said they rubbed because when they compared their work with that of their peers, it appeared different and therefore they wanted to change it. S1 said that "sometimes it is difficult to do things the way they are supposed to be done and you wonder why" (S.Int).

Physics

When required to swing a pendulum and a stop watch at the same time, S5 said,

Am not in control because I have to swing it [pendulum] with my right hand and stop the watch with my left hand and am not able to move [flex] finger in time so I usually stop the watch much later (S.Int).

S4 said that she experienced problems doing hands-on tasks involving the stopwatch because when she pressed it with her right hand index finger, the finger slipped, thus compromising the accuracy of her findings and ultimately her final results. S1 on the other hand said she did not have much of a choice when required to do hands-on activities because, "... if I don't do it, who will do it for me?" she wondered. S5 said she tended to confuse the scale when using rulers especially in physics laboratory and often used the wrong scale.

In the Fleming's left-hand (motor)⁴ and right hand (dynamo)⁵ rules, "I have problems coz [because] I have to first think, this is my left hand and this is my right hand" (S.Int) S4 said while S5 on whether being left-handed contributed to problems in physics said, "it ... it ... it does

⁴ If the first finger, the central finger and the thumb of the right hand are stretched in mutually perpendicular directions such that the first finger points along the direction of the field and the thumb is along the direction of the motion of the conductor, then the central finger would give the direction of the induced current (Abbott, 1984, p.429)

⁵ If the thumb, the first finger and the second finger of the left hand are held pointing at right angles at each other and the first finger is pointing along a magnetic field and the second finger points in the direction of current flow, then the thumb points in the direction which the conductor will tend to move (Abbott, 1984, 449)

contribute sometimes in my exam coz [because] ... for example when you are told to indicate the direction of a magnetic field I make the mistake of confusing my hands” (S.Int)

In summary, handling apparatus and performing hands-on activities in science laboratories was challenging to left-handed students. This was despite having been introduced to practical work and handling of apparatus early in high school. The freedom to consult with the laboratory technician any time they needed help did not help either.

Teacher interviews

In this subsection, teacher interviews are presented under T1, T2, T3, T4 and T5. The focus was to detect the teacher’s awareness of left-handed student’s challenges during practical work and what they were doing to help the students around the challenges.

T1: taught both physics and chemistry and was aware that left-handed students faced challenges. In physics, the challenges were more in the manipulation of some apparatus during hands-on activities and concepts that required the use of a specific hand, for example the Fleming’s right hand rules. In a bid to make themselves comfortable during practicals, T1 said,

... left-handed students stand in a particular way and sometimes they disarrange apparatus. They also do things in the opposite direction from the rest of us, for example, in instances like drawings which causes problems to them ... if the direction of a current in my diagram is from the left, the student’s would flow from the right and this would affect hare results (T. Int).

He further said that “lefties are good in the topic on lateral inversion and they have an advantage over the others” (T.Int). he went on to say that he had realized that left-handed students experienced difficulties associating the Fleming’s rules with the ‘right’ hand as the students tended to confuse the hands, “... for the concepts requiring the use of the right hand,

they] left-handers] cram because they cannot use their right hand well yet they have to pass [their examination] anyway (T. Int).

Writing some of the Greek symbols as is common in physics was also a challenge to the left-handed students, for example the symbol lambda (λ) which T1 said the students were unable to write it the right way. He further said that left-handed students also had problems coping with instructions during examinations because they unfortunately confused their right hand side with the left hand side.

T1 who also taught chemistry said, though in apparent reference L2,

In chemistry when they [left-handed students] are doing a practical where they have to add a substance, stir and time, and they have to use two hands, they find it difficult because they add the substance with the left hand also want to use their left hand for stopping and starting the stopwatch. This takes their time ... in an examination when we realize that they have problems, as teachers, we just leave them alone because there is nothing we can do (T. Int).

T1 did not think that left-handed students needed to be treated as special students because they adjusted on their own and “were doing quite well” (T. Int).

T2: taught home science and although she was aware that S1 the only participant enrolled in the subject faced challenges with some apparatus in the home science room, she had not offered any help. T2 did not think S1 needed extra attention in class because the student never asked for help and she eventually finished her tasks. This was despite the possibility that the students often received help from peers (S. Int). In response to whether T2 thought being left-handed hindered S1’s learning in any way she said,

May be when it comes to practical work coz [because] sometimes even our setting of exam we only think of the right-handed people so even the stitching when we are saying they do [work] to the left, you know for her, [pause] her left is the right so I think it may give her some trouble before she orientates on that. I think that might take time, [pause] can consume time before she puts things together (T. Int)

Despite this awareness, there was still nothing she as a teacher did because she awaited the student to come forward and ‘ask’ for help.

T3: taught both biology and chemistry and became aware that left-handed students faced challenges in the laboratory from their drawings which either faced the opposite direction or did not conform to the norm⁶. In response to what may have triggered the realization that S5 was left-handed, T3 said,

... am interested in the way they [my students] hold the pencil and how sharp and the style of starting the diagram. I expect them to start from left to right even if it's a circle but for them [lefties] they start theirs from the right towards the left and that affects the final diagram In chemistry, I expect the tap to be opened by the right hand [pause] and when you find a student doing vice versa then you want to find out why [long pause] may be its an assumption we make that things should be done in a certain way (T. Int)

T3, a perfectionist of some sort said he had offered to help by training the student on how to draw from left to right⁷ since he had realized that left-handed students diagrams were not conforming to the norm and this was perhaps “beyond their [students] capabilities” (T. Int).

On whether he thought being left-handed hindered S5’s learning in any way, he said,

I would not say directly but indirectly [pause] particularly when it comes to drawing, it does affect their final product ... she may have the concept excellently mastered but presentation on the paper [pause], particularly there's a level of tolerance I have to give for their [lefties] diagrams ... I mark as per the set standard marking scheme ... tolerance in terms of the level of perfection I expect. This is so as not to stretch her [S1] to a level she cannot attain, I expect her diagram to this level [shows]. ... I appreciate there is a level of perfection they [lefties] cannot reach (T.Int).

⁶ The researcher observed this in the biology laboratory during L5 when S5 drew multiple diagrams facing opposite directions. The one different from the teacher’s was later rubbed (L.Obs).

⁷ This was however not observed during the classroom observation as the participant drew both diagrams from right to left with the drawings facing opposite directions (L.Obs)

In chemistry, T3 said that the manipulation of apparatus during hands-on activities was a major challenge because left-handed students sometimes had to first rearrange the apparatus for comfort. They also preferred working with some apparatus over others.

While handling apparatus, T3 said he had taken to 'dictating' to left-handed students on how to arrange and organize apparatus. This, he said had helped a lot in the left-handed student's practical work outcomes. The help offered by T3 was out of his own initiative; he took a keen interest in each individual student in his classes.

T4: the boarding mistress was in charge of structures in the school said there was no provision for left-handed students' needs because "there's nothing wrong with them. They have learned to cope with what there is" (T.talk). This opinion was shared by the deputy principal, T5.

T5: the school deputy said that she was aware there were left-handed students in the school but she did not know how many they were. She learned about their presence through observation as they carried out their duties. She confirmed that there were no structures especially meant for left-handed students because they appeared normal to her. In her opinion, there was nothing special about left handedness because "none of the students had expressed the need to be treated as such and they were able to cope with their condition in the given circumstances" (T.talk)

Notably, the nature of challenges left-handed students face in the learning institutions could determine their future career choices. In this study, S2 opted to do physics instead of home science because the challenges she experienced in home science frustrated her efforts while S1, despite the challenges, still went ahead with the subject but felt that she did not perform her best due to the difficulties with the apparatus provided. S1 also blamed her low performance on the lack of help from her teacher.

DISCUSSION AND SUMMARY OF FINDINGS

The study purpose was to investigate the challenges left-handed students face generally in school and specifically in the school science laboratories. It also sought to find out whether teachers were aware of these challenges and the help they lend to the students. The findings have been synthesized from both teacher and student interviews and classroom observations in relation to the research questions. The syntheses is done under the subheadings; cultural attitudes, handwriting, sitting preferences, manipulation and handling of apparatus and lastly teacher awareness and preparedness.

Cultural attitudes

Despite a commonly accepted view that prejudice against the left-handed is a thing of the past [9], left-handers still face a lot of humiliation from the modern society. In this study, S5's parents had to take her to a doctor hoping to get a 'cure' for her good hand. In the process of trying to convert her handedness, S1 may have developed stuttering, a condition resulting from being forced to perform tasks with the less coordinated hand [9]. As a result, S1's academic performance may have suffered because as explained by her teacher T3, she was not enthusiastic about verbal responses in class, yet children learn better when they are able to verbalize their thinking [11]. S2 implied that her father thought she was inefficient in carrying out some activities in the home as he often offered to assist her (see exact words in the findings section). The constant reminder by her parents that she ought to be careful when carrying out activities may have eroded S2's self esteem to a point she did not want to take initiatives for fear of failure.

Handwriting

Writing left-to-right is a challenge the left-handed encounter in school. This is because most of their teachers are right-handed and they may not have any idea on how to train a left-hander to hold the pencil and tilt the paper/book when writing. The aches reported by the participant students may have been due to twisting their bodies because of sitting on the 'wrong desks' [12], unfavorable sitting positions [5] and also having the wrong writing habits. However, all participants but S2 had very clear handwriting. S1 and S5 pressed the pen very hard causing cramps to their arms and fingers and ultimately tiring easily during note taking [9]. This eventually made them to sometimes fall behind the teacher and the rest of the class a reason that may explain their failure to finish timed tasks

Being left behind and having to copy notes from others may lead to labeling by the same peers and accusations of being a burden, leading to eventual withdrawal from active class participation and therefore limited associations. It is this fear of stigmatization that probably made the participants to say that they had to work extra hard to catch up with their peers and they felt obliged to prove their worth. Falling behind the teacher in note taking could also have affected their class performance since students spend most of their free time catching up instead of preparing for their examinations and routine class assignments and class work. For this reason, left-handed students may need extra support due to the difficulties encountered during writing or undertaking other tasks within the school.

Sitting preferences

Participants in the study preferred sitting on the left hand side of the room or at the edge to avoid knocking elbows with their right-handed mates. Often, they felt obliged to create a

conducive working environment for themselves and others by readily moving more so when the preferred sitting positions were unavailable or when their peers failed to understand their concerns which resulted in frustrations.

The readiness of left-handed students to create comfort for everybody else as depicted by the participants in the study could have been as a result of pressure and stress of being left handed. It can have its toll on their self esteem particularly if not recognized, understood and supported [5]. The provision of a relaxed learning environment could be a boost to better results as opposed to situations where students have to ‘fight’ for space and comfort.

All the participants were interested in class activities particularly teacher demonstrations, both group and individual work. However, individual differences and preferences came in the way for them. S1, S2 and S5 preferred positioning themselves on the same side of the demonstration table as the teacher. S5 said that she was able to ‘see things better’ from the teacher’s side (S.Int).

Left-handedness and left-handed students therefore need not be seen as a single entity. From the discussion, there were those students who preferred seeing things the way they were (S1, S2, S5) and those who preferred the mirror image (S3, S4). Standing on the same side as the demonstrator helped them visualize things as though they were seeing the mirror image [12].

In the laboratory, the participants preferred working facing the rest of the class because “there is more space” (S3). But since they are known to prefer mirror imaging and as T3 said they are good in the topic on “lateral inversion” it was possible to be accused of cheating in examinations. Rather than this accusation or be seen as “boasting” (S2), left-handers in this study said it was better to work uncomfortably than have their grades cancelled by the teacher.

Manipulation and handling of apparatus

Apparatus in use in the laboratories either require a left-to-right wrist turning or have a right hand in-built advantage [12] and therefore a left-handed student will experience difficulties working with them. Activities that require the use of two hands concurrently for example starting and stopping a stopwatch with one hand while swinging a pendulum with the other, using a pipette for measuring exact volumes which require flexing the right hand index finger in controlling fluid flow, mixing/stirring, swirling and shaking with the right hand were reported to be challenging. Since the right hand ‘feels weak and somehow ineffective’ (S2), this results in clumsiness; a confirmation that left-handed students are both clumsy and have poor motor abilities [5].

Clumsiness and poor motor abilities as observed during lesson observation L2 in the chemistry laboratory is a ‘costly affair’ for the left-handed. As evidenced during the lesson, the group members were forced to redistribute themselves into other groups after their contents were messed up and stopped the stopwatch at the wrong time.

Apparatus such as sewing machines made specifically for manipulation by the right hand supported by the left hand posed challenges to S1. For this participant, she also had problems using the tracing wheel and making straight lines and her stitching and stitching lines came out crooked “no matter how much I try” (S.Int). The stitches have to be done in a uni-directional way, for example, if it is required that stitching is done from left-to-right, a student who does it in the opposite direction is penalized by the examiner. Sadly, left-handed learners will probably and effortlessly take this direction when doing their stitching. Further, there is a certain tension that is expected for the stitches. Since the learners will be using the less coordinated hand, the stitches are likely to come out loose leading to lose of more marks.

What S1 and her teacher T2 did not realize was that her stitches and stitching lines came out crooked because of impaired hand-eye coordination. The stitching line was obscured by her left hand since the apparatus was meant for the right handed user.

Left-handed students will do things in the way that feels most natural for them until they ‘remember’ to change as was observed with S5 during L5. She first drew the rib facing the left hand side until she remembered the requirements of the task. These accommodations are time consuming and especially so in examination situations when they fail to follow instructions.

The tendency to compare their work with the right handed peers is a signal that they probably feel inadequate and may use the right-handers work as ‘yard sticks’ for excellence and when they fail to measure up, they may lack self-esteem and self-confidence.

Teacher awareness

While the teachers were aware of the challenges faced by the left-handed students in the classes, majority of the teachers left the students to deal with the challenges on their own. The students on the other hand preferred talking to their peers about their challenges in the hope of solving their problems “without much fuss” (S.Int). This consciousness saturation and the intrinsic acceptance of their condition (left-handedness), the students may have failed to see the need to ask for help from their teachers, for the same reason the teachers did not offer the help.

T1 was aware that left-handed students faced challenges. But although he understood that in the laboratory the left-handed students had to “stand in a particular way” (T.Int), he did not offer any help and left the student to deal with the challenge on their own. In Physics too, he also knew that they had problems associating the Fleming’s rules with the ‘right’ hand as well as

following directions and instructions. His assertions therefore depicted an awareness that did not match the help offered.

T2 was equally aware that S1 had problems in the science room and especially while using a pair of scissors and stitching along straight lines. Since the student did not ask for help and that “she eventually finishes her work” (T.Int), the teacher, T2 did not think S1 needed extra help. For that reason, she left the student to deal with the challenge the best way she knew how.

T3 had taken an initiative to train his left-handed Biology students on how to draw (refer to previous section). While this evidenced his awareness of the challenges encountered by S5 while drawing, he had no record of previous training in special education. Evidently therefore, teachers’ intuitive practices and training (or lack of it) could shape their classroom practices a great deal. T3 was guided by his interaction with his students and his interest in their work. Though the relationship between training and practices may be distorted, there is a high chance of inclusion if teachers enlarged their perspectives and gave each student a chance to be.

Contrary to the science subjects’ teachers, the deputy principal and the boarding mistress had similar assertions that revealed their unawareness of the challenges left-handed students faced during learning. The deputy principal, who was herself a teacher of Biology in the school said that “left-handedness is not a special learning need and none of the students has expressed the need to be treated as such, they [left-handers] are able to cope with their condition in the given circumstances” (T.talk). The boarding mistress on the other hand said that “there is nothing wrong with them [left-handers] because they have learned to cope with what there is” (T.talk). Such views by the school administration could therefore explain the absence of structures to support left-handed students. The particular emphasis that there was nothing wrong with being left-handed was a confirmation that left-handedness is not seen as a special learning need.

In summary, the findings in this study seem to evidence that handwriting; school structures, handling and manipulation of laboratory equipment and time taken by students as they struggle with apparatus pose the main challenges left-handed students have to deal with in school. Also, negative cultural attitudes towards left-handedness and the left-handed have their subtle way of affecting learning outcomes.

In this section, I have presented a summary of key findings with particularly mention of the challenges left-handers experience in carrying out practical work and the teacher awareness of the said challenges and what help they give. In the next section, I have concluded the study by giving an overview of what findings signify as far as the way forward on how teachers, schools and educators can be involved in making the left-handed students learn with least discomfort.

CONCLUSIONS

In this section, the researcher looks at what the conclusions imply for policy. It is hoped that the suggested way forward would help shape educators way of handling children with special learning needs generally and specifically the left-handed for a fully inclusive classroom and in tandem with EFA goals.

The findings from this study point to the fact that left-handed students experience numerous challenges in school generally and specifically in the science laboratories. The findings also confirm that teachers are aware of the challenges faced by the left-handed learners in school and in the classrooms. However, they offered insufficient help. Since the participant teachers got their training in Kenya, these findings serve to confirm that initial teacher training colleges do not train teachers on handling left-handedness in the classroom.

The findings in this study, conducted in a developing country, correspond to similar findings in developed countries in previous studies [9, 21-23). It therefore seems that left-handed children experience challenges the world over. The participants in this study were from a national school (high academic achievers). The challenges they experienced like their inability to complete timed tasks and handling and manipulation of laboratory apparatus adequately due to their special learning need can only mean that other left-handed students in less endowed schools and with lower academic ability could be facing serious problems. The findings in the study therefore make it possible to make certain suggestions to ease the challenges the left-handed students face in classrooms and laboratories.

Learning hands-on

Left-handed students need to be given more time in order to compensate for time spent making the necessary adjustments and accommodations. This way they will be able to complete the timed tasks therefore building their self-confidence and self-esteem. This way their gifting in the sciences, arts and mathematics due to their sequential nature of processing information [24] could easily be tapped if placed in non-threatening learning environments.

Handwriting

Training a left-handed learner how to write from left to right by a right-handed teacher who had never been trained on how to do it could be challenging to both the teacher and the learner. The learner ought to be advised to hold the pen slightly higher up the shaft than a right-handed learner as this helps them to see what they are writing and do not have to bend over their work, thereby avoiding a possible back, neck, shoulder and hand aches. The book can also be

tilted approximately 90⁰ to the right so as to allow strokes to be made both on the flat and the sloping desk. Teachers should be made aware of the need to encourage such students to sit with their bodies turned slightly to the right so as to allow greater freedom for movement to avoid the aches and fatigue caused by using the wrong furniture. Students can also be introduced to word processing which is less demanding on their writing needs. This approach would however work in schools which have computers or parents can afford laptops for their children.

Sitting positions

Left-handed students need to be discouraged from sitting with their bodies twisted or from bending over their work. The lighting in the rooms should also be in such a way that does not cast shadows over their work as they write. If left-handed students were allowed to sit or stand where they preferred to during class or task taking would ease their discomfort a great deal. It would also help to save some time taken during shifting.

The role of teacher education and in-service programs in teacher awareness

Participant teachers, although they were all trained and qualified did not seem to understand the needs of left-handed students. It is therefore imperative that all teachers are made aware of the special needs of the left-handed, an awareness that ought to cut across all teacher training institutions from early childhood to the universities so that as the left-handed children exit from pre-primary to primary and later secondary school, they are psychologically aware of their unique needs and they can learn to adapt even better. There is therefore the need of a paradigm shift in the training of teachers because teachers in this study were not unique to the school. The government through the ministry of education, science and technology could review

the teachers' training curriculum and include a module on recognizing and handling special needs cases in class. This empowers teacher in identifying left-handed children and mediating using effective measures with corrective techniques which may help improve performance.

First and foremost, left-handedness ought to be recognized as a special learning need at least based on this study findings. Although KISE has started school based in-service courses for special needs education trainees, left-handedness was not recognized as a special learning need. The ministry could supplement KISE's efforts by organizing courses at both local and national levels for all teachers with a specific target of handling children with special learning needs and tapping in to the experience of regular teacher through reflective practice.

Awareness programs aimed at changing the attitudes of parents and peers are also very necessary. This would help at educating the community on the unique needs of left-handed children and the challenges they face in school. This can successfully be done through the help of resource persons, symposia, teach yourself leaflets and persuasive appeals involving mass media.

Resources

As evidenced in this study, resources need to cater for the needs of all children through the provision of the minimum requirements

This research was carried out in a girls' only institution with a sample of only five girls and only looked at the challenges they faced. Further research with older participants and across gender would be appropriate to determine whether the same or similar challenges are faced by the students.

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