Art. #1894, 11 pages, https://doi.org/10.15700/saje.v41n2a1894

The predictive influence of gender, onset of deafness and academic self-efficacy on the attitudes of deaf learners towards Biology

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In the study reported on here we examined the attitudes of deaf learners towards biology in Ibadan, Nigeria. Forty-one deaf learners (28 males; 13 females) in the Secondary School II science classes from 3 government-funded secondary schools for the deaf were purposively selected for the study. In the study we adopted a descriptive survey research design of the correlational type. Four research questions were raised and answered. A structured questionnaire, "Deaf Learners and Biology Questionnaire" with a reliability coefficient of 0.81, was used for data collection. Data were analysed with descriptive statistics and inferential statistics of Pearson product moment correlation, multiple regression and *t*-test at 0.05 level of significance. There was a positively significant relationship between academic self-efficacy and the attitudes of deaf learners towards biology ($r = 0.511$; $p < 0.05$); a significant but negative relationship between gender and the attitudes of deaf learners towards biology ($r = 0.15$; $p < 0.05$). No significant relationship between the onset of deafness and the attitudes of deaf learners towards biology ($r = 0.810$; $p > 0.05$) was observed. A total of 58.1% of the variance of the independent variables accounted for the attitudes towards biology among deaf learners who participated in the study. We conclude that academic self-efficacy has a great effect on the attitude of deaf learners towards biology. Gender contributes to and is inversely proportional to learners' disposition towards biology. In light of the findings, appropriate recommendations are made.

Keywords: academic self-efficacy; attitude towards biology; deaf learners; gender; onset of deafness

Introduction

The percentage of deaf learners in sciences have continued to decline, resulting in deaf learners being underrepresented in sciences. Annually, less than 50 deaf individuals receive higher degrees in science, technology, engineering, and mathematics (STEM) (National Science Foundation, 2009). Unfortunately, until now, the percentage of deaf learners learning towards achieving degrees in STEM is not encouraging. Norris (1975) indicates that even with superior intelligence and efficient psychomotor abilities, deaf learners are at a great disadvantage in acquiring scientific skill due to difficulties in language capacities. Additionally, Lalley (2011) and Ogundiran and Olaosun (2013) aver that difficulties in following logical lexical rules exert a great deal on the potential of deaf learners to read and write with acceptable form and meaning in science subjects – especially in biology. Biology is a science subject that places high value on the principles of scientific knowledge, skills, processes and development of the right attitudes between humans and the environment. Among all science subjects, biology places a high value on spelling and lexical structures. Hence, the deviation from rightful description of biological concepts and phenomena is not encouraged and accepted (West African Examination Council, 2017).

Above all, irrespective of learners' hearing ability, the biology curriculum in Nigeria is designed to make learners conscious of the ecosystem and constructs, and apply biology knowledge to develop the abilities to creatively think and make scientific inquiries towards participating in and contributing to the rapidly increasing scientific and technological world. Based on the aforementioned values, the Nigeria Policy on Education (Federal Republic of Nigeria, 2008) mandates that all learners in Nigerian secondary schools should be exposed to biological sciences. Over the years, learners have been subjected to general assessment of their knowledge in all subjects, including biology, through the West African Senior School Certificate Examination and/or the National Examination Council. The National Examination Council report (2011–2015), as indicated by the National Bureau of Statistics (2017), reveals the extremely poor academic performance of learners who wrote the general assessment in biology. According to the National Bureau of Statistics (2017), the failure rates were 34.44% (2011), 49.01% (2012), 35.88% (2013), 34.48% (2014) and 21.31% in 2015.

Evidence from Kenya was that the performance of learners who sat for the Kenya Certificate of Secondary Education in biology was relatively low (Owino, Yungungu, Ahmed & Ogolla, 2015; Siringi, 2010) since 2004. According to the Owino et al. (2015) and Siringi (2010) there was a decline in the pass rate in biology from about 12.03% in 2004 to 5.88% in 2010. Other studies outside Africa have also shown variance in the attitude and achievement in biology. For instance, Dong (2002) reports a low interest and moderate attitude towards biology among non-native English speaking high school learners in New York City who wrote the 1998–1999 school year Regents biology exams. Native English speaking learners achieved higher scores and showed a more positive disposition towards biology than their non-native English speaking counterparts. While the above studies reveal the performance in biology among non-deaf learners, it is quite unfortunate that studies which assess the performance of deaf learners in biology is scarce.

Literature Review

Several studies have been conducted on the academic performance of learners. Thomas (2013) states that the low performance among learners can be linked to teaching praxis and unwholesome interactions among learners and their teachers, motivation and readiness to teach and learn scientific concepts. While Thomas also attributes poor performance of learners in sciences to poor motivation, teaching habits, and teachers' negative attitudes toward the learning and teaching of sciences, Ali, Haider, Munir, Khan and Ahmed (2013) consider medium of instruction in schools, learners' perceptions, age and gender as predictors of learners' performance. Lebata and Mudau (2014) have identified learner and parental factors as prominent factors that contribute to low performance in biology.

Wang and Degol (2016) view socioeconomic characteristics of learners as risk factors for expected learning outcome. Berkowitz, Moore, Astor and Benbenishty (2017) assert that school climate is directly related to academic performance, academic expectations and high-quality teacher-student relationship. Klomegah (2007) mentions the associative effects of demographic factors and previous experiences with learners' performance. However, Alshammari, Saguban, Pasay-an, Altheban and Al-Shammari (2018) aver that factors that influence science performance are more internal (intrinsic) than external factors, such as school climate, use of instructional materials, and parental/family background. The studies mentioned above reveal that academic performance of learners across various domains has been the focus of research. However, issues relating to achievement in science and attitudes towards science among deaf learners have to date not received sufficient attention.

As noted by the World Health Organization (2012), 25 decibels (dB) is recognised as the threshold for normal hearing; deviation from the normal hearing level is a signal of deafness, which is significant enough to affect social interaction and learning outcomes. Deaf learners represent members of a sociolinguistic minority group whose organs of hearing are non-functional. According to Marschark and Hauser (2012), educational performance of deaf children is adversely affected by difficulties in processing and comprehending linguistic individuals because of their deafness. Deaf learners lag behind in language and literacy skills. In other words, they lack competence in responding to auditory-verbal clues; they exhibit great challenges with reading and writing. Deaf individuals extensively use natural gestures, and sign language; some of them use a combination of speech, which might be difficult to easily understand, to interact with their deaf or hearing peers. Owing to the difficulties experienced in speech and hearing, deaf learners experience various challenges in their academic activities.

Research in South Africa (Glaser & Van Pletzen, 2012), Kenya (Mweri, 2014; Owino et al., 2015), and Nigeria (Adigun, 2017) indicates that deaf learners lag behind in science assessment more than their hearing peers at the same grade levels. In a national sample study in the United States of America, which measured comprehension skills and science, Traxler (2000) states that about 50% of the sampled deaf and hard-of-hearing learners performed below the basic proficiency level in science and comprehension skills. Various approaches have been implemented to improve teaching and learning sciences, especially biology, to the deaf learners, but with little or no positive results. While recent studies have focused on teaching strategies, the attitudes of deaf learners towards biology is understudied.

Attitude towards learning is a unique and complex phenomenon that is proportional to academic achievement. Attitude reflects learners' positive or negative beliefs, feelings and preferences towards a phenomenon. Prokop, Tuncer and Chudá (2007) remark that attitudes of learners reflect learning outcomes. This implies that a student's attitude is an essential component that is directly proportional to academic achievement, particularly in disciplines like chemistry, physics and biology. Learners' attitudes towards scientific disciplines have been studied but with diverse findings. While some researchers found positive attitudes towards science subjects, others reported negative dispositions; and some studies reported an insignificant impact of gender on science disciplines. These reports were influenced by dynamics of learners' internal and external environmental conditions. Gender and sciences have remained one of the greatest issues in sciences. Some studies, such as Greenfield (1997) and Nasr and Asghar (2011) found no relationship between gender and learners' attitudes towards sciences. However, Simonneaux, Albe, Ducamp and Simonneaux (2005) found male learners to be more favourably disposed to scientific instruction than their female counterparts. Prokop et al. (2007) and Usak, Prokop, Ozden, Ozel, Bilen and Erdogan (2009) assert that girls are more favourably disposed to biology than boys. Jones, Howe and Rua (2000) revealed that girls were more positive towards biology, while boys were more positive toward physics and chemistry.

Irrespective of gender and conflicting reports on attitude towards biology and sciences in general, one phenomenon that is peculiar to the deaf community is the time of occurrence of deafness, which is not always the same. While some individuals sustain deafness before the acquisition of speech and language, others develop the ability to speak and respond to speech stimuli but loose

such potential due to various causes (Adigun & Iheme, 2020; Lawal & Osisanya, 2017; Mulwafu, Kuper & Ensink, 2016). With regard to the time of occurrence, deafness as a condition has been dichotomised into prelingual and postlingual deafness. Bakare (2013) posits that learners with prelingual or postlingual deafness have different dispositions, potential and opportunities to learn and react to issues. Learners with postlingual deafness have better prospects in science instructions than those with prelingual deafness since a great deal of academic instruction is done orally rather than manually (sign language).

However, it may be very difficult for an individual who has previously experienced the ability to speak and respond to verbal stimuli to adjust and face the reality of being postlingually deaf. At this point, unlike the case with prelingual deafness, such individuals may have stressful psychosocial adjustment patterns and greater degrees of dissatisfaction (Loeb & Sarigani, 1986). Altshuler (1976) found greater impulsivity tendencies among persons with profound early deafness than among the hearing population. In the same vein, Polat (2003) notes that the age of onset, either prelingual deafness or deafness that occurs after the acquisition of speech and language, is a powerful predictor of psychosocial adjustment, which is an important determinant of learning outcomes among deaf learners. Polat established a positive relationship between psychosocial variables and academic achievement; and associated poor psychosocial adjustment among deaf learners with the time such learners sustained hearing loss. Ogundiran and Olaosun (2013), while comparing academic achievement of learners with congenital and acquired deafness in a Nigerian college, found no significant difference in the academic achievement of learners with congenital deafness and those with acquired deafness.

Braithwaite and Thompson (2000) as well as Cheng, Zhang and Hu (2016) view the deaf, irrespective of onset of deafness, as a group of individuals with primary cultural attributes and hearing disability that affect their sense of reality, behaviour, perceptions and personal judgments. All these can reshape and influence their academic pursuits and accomplishments. Bandura (1997) conceptualises self-efficacy as a domain that influences personal judgment, perception and behaviour. Self-efficacy theory states that the existing relationship of assigned tasks and learners' personal thoughts defines success rates and behaviour towards a particular phenomenon (Zhu, Chen, Chen & Chern, 2011). In other words, self-efficacy has the capacity to influence behavioural change geared towards accomplishment of a particular task of learners. Researchers have now integrated the word "academic" into self-efficacy and it has opened a new vista to the examination of diverse aspects of the learning and teaching process. Academic self-efficacy refers to individuals' convictions about the ability to perform and succeed in given academic tasks at designated levels (Schunk, 1991; Zimmerman, 2000). Hence, academic self-efficacy could refer to learners' perceptions of their competence to effectively do their best in biology and other subjects.

According to Multon, Brown and Lent (1991), academic success is significantly predicted by increased academic self-efficacy. Zimmerman, Bandura and Martinez-Pons (1992) reveal how academic self-efficacy influence learning strategies, specifically self-regulated learning and dispositions towards learning, in addition to its impact on learning and performance. Self-regulated learning, which includes planning, goal setting, self-evaluation and self-monitoring, contributes positively to academic achievement (Woolcock, Creevy, Coleman, Moore & Brown, 2016). Erdem (2015) found an increase in the scores of self-efficacy and attitude towards chemistry in relation to grade levels. In other words, learners' attitudes towards chemistry and their chemistry self-efficacy were positive. According to Erdem's findings, it can be said that learners with high self-efficacy have high attitudes towards chemistry.

Kundu and Ghose (2016), in a quantitative study which assessed the relationship between learners' attitudes towards mathematics and self-efficacy, found a highly significant relationship between the two variables. Their findings corroborated those of Stramel (2010) and Usher (2009) that indicate an affinity between learners' attitudes towards a particular task and self-efficacy beliefs. Gopal, Salim and Ayub's (2018) analysis revealed that statistics engagement positively related to attitudes towards statistics and learners' self-efficacy. Self-efficacy was a potential construct in predicting attitudes towards statistics and statistics engagement. Participants' attitudes towards statistics vis-à-vis self-efficacy accounted for 50% of the variance observed in statistics engagement.

Schunk (1991) claims that learners' self-efficacy would affect their attitudes in learning due to the difference in their beliefs about their capabilities to perform skills, master learning materials, and obtain knowledge. Hence, communication isolation experienced by deaf children and adolescents can negatively impact their beliefs about their abilities to navigate life challenges (Delich & Roberts, 2016). Most of the deaf learners in science classes, particularly biology classes, do not do well when compared to their hearing peers (Adigun & Iheme, 2020). Teachers, parents, researchers and other stakeholders interested in science incubation of learners for the anticipated fourth industrial

revolution have raised concern about the recurrent abysmal performance of deaf learners in science subjects. While studies (Gopal et al., 2018; Kundu & Ghose, 2016; Stramel, 2010; Usher, 2009) have determined the attitudes of non-deaf learners towards science subjects and biology, there is a dearth of studies designed and initiated to investigate the disposition of deaf learners towards biology. Previous studies have assessed the components of the severity of deafness (Daud, Noor, Rahman, Sidek & Mohamad, 2010; Fitzpatrick, Gaboury, Durieux-Smith, Coyle, Whittingham & Nassrallah, 2019) and perceived psychosocial determinants of academic performances (Al-Emran, Elsherif & Shaalan, 2016; Gulzar, Ali, Aijaz & Hussain, 2010) towards some subjects. However, until now, there has been limited research on the effects of gender, the onset of deafness (prelingual deafness and postlingual deafness) and academic self-efficacy on the attitudes of deaf learners towards any specific subject. Therefore, we studied the predictive influence of gender, onset of deafness and academic self-efficacy on the attitudes of deaf learners towards biology. The aim of the study was to

- determine if any significant relationship existed between independent variables (gender, onset of deafness and academic self-efficacy) and the attitudes towards biology (dependent variable),
- examine the joint relationship between independent variables and dependent variable,
- determine whether there is a significant relative contribution of independent variables on dependent variable and,
- determine if a significant difference existed in the attitudes of participants towards biology based on (i) their onset of deafness and (ii) gender?

Research Questions

Based on the above objectives, this study was guided by the following research questions:

- Is there any significant relationship between gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?
- Is there any significant joint relationship between gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?
- Is there any significant relative contribution of gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?
- Is there any significant difference in the attitude of the participants towards biology based on (i) their onset of deafness and (ii) gender?

Theoretical Framework

This study was anchored in the Theory of Planned Behaviour (TPB) (Ajzen, 1985) which describes how human behaviour is predicted by an intention. Ajzen notes that, for accurate prediction of human behaviour, there is a need for the intention to be measured to correspond to the behaviour that is to be predicted, such behaviour must remain stable, and there should be accuracy of perceived behavioural control. In relation to the TPB, this study was conceptualised among learners who were either prelingually or postlingually deaf. All the participants had communication difficulties and similar psychological attributes. In order to assess the attitudes of deaf learners towards biology, we argued that, in consonance with the TPB, that the disposition of deaf learners toward biology was not only influenced by communication difficulties, but also by other behavioural components.

Various studies, for instance Ajzen (2012), Teo and Beng (2010), and Yakasai and Jusoh (2015), have applied this model to describe dispositions towards various phenomena, but with varied findings. However, few studies have used this theory to explain deaf learners' attitudes toward academic performance. We adopted this theory because it provides basis for understanding deaf learners' attitudes towards biology.

Methodology

The study was a quantitative study in which we adopted a descriptive survey research design of the correlational type. The quantitative correlational research design was found suitable for this study because it attempted to quantify the relationship between combinations of variables (gender, onset of deafness and academic self-efficacy [independent variables] and the attitudes of deaf learners towards biology [dependent variable]). According to Creswell (2005), the quantitative correlational research design which gained much attention in the mid-20th century is used to describe in quantity the relationship or association existing between two or more variables. An existing quantified relationship determined through correlation is computed and analysed on computer using data analysis software packages such as the Statistical Packages for Social Sciences (SPSS) (Creswell, 2005). Hence, the descriptive survey research design of the correlational type in this study was used to determine the pattern of the relationship between gender, onset of deafness, academic self-efficacy and attitudes towards biology among deaf learners at the Secondary School II in Ibadan Oyo State, Nigeria. The participants were purposively selected from three government-funded secondary schools for the deaf situated within the Ibadan metropolis, Nigeria. We used the exact population of Secondary School II deaf learners found in the three selected schools. Forty-one deaf learners in the science classes participated in the study after approval had been granted by the school administrators. Before then, approval had been received from the Research Committee of the Department of Special

Education, University of Ibadan, Nigeria. We ensured that all research ethics were strictly observed. Data for this study were collected using a structured and standardised questionnaire, "Deaf Learners and Biology Questionnaire." The questionnaire consists of sections A, B and C. Section A assesses and collates demographic data from the participants. The participants were given opportunity to indicate the time of onset of their deafness, gender and age in Section A of the research instrument. Section B sought responses from the participants on their academic self-efficacy through a 20-item modified version of Morgan-Jinks learners' Self-efficacy Scale (Jinks & Morgan, 1999). Section C, which measured deaf learners' attitudes towards biology, consists of a 40-item scale developed by Ige (1998). The 20-item and 40-item scales for academic self-efficacy and attitude towards biology were designed in a four-point Likert scale: Strongly Agree, Agree, Disagree and Strongly Disagree.

The research instrument was revalidated using the test-retest reliability procedure at Durbar Grammar School, Oyo, Oyo State, Nigeria. The distance between Oyo and Ibadan is 52 kilometres (32 miles). Twelve deaf learners in the science class at the Durbar Grammar School, Oyo, were requested to complete the questionnaire for the purpose of validation. The instrument was found to be reliable at $\alpha = 0.81$. Data generated from the research instrument were analysed using descriptive statistics of frequency count and simple percentage as well as inferential statistics of Pearson product moment correlation, multiple regression and *t*-test at 0.05 level of significance. Data generated through the research instrument were analysed using the IBM SPSS version 23.

Results

Table 1 Demographic distribution of the study participants

Parameters		*F*	%	*M*/*SD*
Gender	Male	23	56.1	1.43 ±
	Female	18	43.9	0.50
Age	13–15	3	7.3	2.15 ±
	16–19	29	70.7	0.53
	20–25	9	22.0	
Onset of deafness	Prelingual	13	31.7	1.68 ±
	Postlingual	28	68.3	0.47

Table 1 shows that 23 (56.1%) male and 18 (43.9%) female deaf learners participated in the study. Only 31.7% (13) of the study population reported prelingual deafness, while 68.3% (28) reported postlingual deafness. Out of the 41 deaf learners who participated in the study, 3 (7.3%) were in the age range of 13 to 15 years; 29 (70.7%) were in the age range of 16 to 19 years and only nine (22.0%) were in the age range of 20 to 25 years.

Research Question 1: Is there any significant relationship between gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?

Table 2 Relationship between gender, onset of deafness and academic self-efficacy and attitude towards biology

		Gender	Onset of deafness	Academic self-efficacy	Attitude to biology
Gender	Pearson correlation	1			
	Sig. (2-tailed)				
	N	41			
Onset of deafness	Pearson correlation	.075	1		
	Sig. (2-tailed)	.643			
	N	41	41		
Academic self-efficacy	Pearson correlation	-.211	.076	1	
	Sig. (2-tailed)	.186	.637		
	N	41	41	41	
Attitude towards biology	Pearson correlation	-.377*	.039	.511**	1
	Sig. (2-tailed)	.015	.810	.001	
	N	41	41	41	41

Note. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). Sig. = Significance.

Table 2 captures the relationship between gender, onset of deafness, academic self-efficacy and attitude towards biology among the deaf learners. The results show a significant and positive relationship between academic self-efficacy of the deaf learners and their attitude towards biology ($r = 0.511$; $p < 0.05$), and a significant but negative relationship between gender and attitude of deaf learners towards biology ($r = 0.15$; $p < 0.05$). However, we found no significant interconnectedness between onset of deafness and attitude of deaf learners towards biology ($r = 0.81$; $p > 0.05$).

This finding implies that the influence of self-awareness and ability to perform and complete a given task is a factor that drives the attitude of deaf learners towards biology. Also, although gender influences deaf learners' attitudes towards biology, we have shown that there is an inverse relationship between gender and attitude of deaf learners towards biology. While attitude towards biology seems to improve, there was a downward trend in

the influence of gender on the subject among the deaf participants in this study. In terms of the onset of deafness, we found that, irrespective of the time that an individual sustains deafness, the effect of the condition on people's disposition towards biology is similar. Therefore, whether the case was prelingual or postlingual deafness, deaf learners' attitudes towards biology never differed.

Research Question 2: Is there any significant joint relationship between gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?

Table 3 Joint relationship between gender, onset of deafness and academic self-efficacy and attitude towards biology

Model summary				
Model	*R*	R^2	Adjusted R^2	Std. error of the estimate
1	.581[a]	.338	.284	8.07916

Note. [a]Predictors: (Constant), Academic self-efficacy, onset of deafness, and gender. Std. = Standard deviation.

ANOVA[a]						
	Model	*SS*	*df*	*MS*	*F*	Sig.
1	Regression	1231.688	3	410.563	6.290	.001[b]
	Residual	2415.093	37	65.273		
	Total	3646.780	40			

Note. [a]Dependent variable: Attitude to biology. [b]Predictors: (constant), academic self-efficacy, onset of deafness, and gender.

Table 3 reveals a joint significant relationship between academic self-efficacy, onset of deafness, gender and attitude towards biology (R = 0.34) among deaf learners in biology class. Approximately 58.1% of the variance in academic self-efficacy, onset of deafness and gender accounted for the attitude towards biology among the deaf participants in the study. The joint relationship was also shown to be significant ($F_{(3,37)}$ = 6.290, $p < 0.05$). This implies that the three components of academic self-efficacy, onset of deafness, gender together have a combined influence on the attitudes of deaf learners towards biology.

Research Question 3: Is there any significant relative contribution of gender, onset of deafness and academic self-efficacy (independent variables) and attitude towards biology (dependent variable)?

Table 4 Relative contribution of gender, onset of deafness and academic self-efficacy and attitude towards biology

Coefficients[a]						
		Unstandardised coefficients		Standardised coefficients		
	Model	B	*SE*	Beta	*t*	Sig.
1	(Constant)	94.186	10.860		8.673	.000
	Gender	-5.401	2.612	-.284	-2.068	.046
	Onset of deafness	.521	2.731	.026	.191	.850
	Academic self-efficacy	.543	.166	.449	3.269	.002

Note. [a]Dependent variable: attitude towards biology.

Table 4 reveals the relative contribution of academic self-efficacy, onset of deafness and gender to the attitude of deaf learners towards biology. The table shows that there was a significant but negative contribution of gender towards learners' attitudes towards biology (β = -.284, t = -2.068, $p < 0.05$); but no significant contribution of onset of deafness (β = .026, t = .191, $p > 0.05$) to attitude of learners towards biology; while academic self-efficacy (β =.499, t = 3.269, $p < 0.05$) had a positive significant contribution to deaf learners' attitudes towards biology. The results in Table 4 show that academic self-efficacy had the highest contribution to the attitudes of deaf learners towards biology, followed by gender. This implies that academic self-efficacy has a great effect on the attitudes of deaf learners towards biology and this can affect their achievement in biology. Moreover, we found that gender contributed to learners' disposition towards biology but its implication for learners' attitude was inversely proportional. However, the onset of deafness has no contribution to the disposition of deaf learners towards biology.

Research Question 4: Is there any difference in the attitude of the participants towards biology based on (i) their onset of deafness and (ii) gender?

Table 5 Differences in attitude towards biology among participants based on their onset of deafness and gender

1) Attitude towards biology among the participants based on onset of deafness

Onset of deafness	*N*	*M*	*SD*	*df*	*F*	*t*	Sig
Prelingual	13	115.54	13.07	39	4.10	-0.24	0.05
Postlingual	28	116.32	7.68				

2) Attitude towards biology among the participants based on gender

Gender	*N*	*M*	*SD*	*df*	*F*	*t*	Sig
Male	28	119.22	8.44	39	0.310	2.54	0.58
Female	13	112.06	9.59				

The results in Table 5(1) show a slight difference in the attitudes of learners with prelingual deafness ($\dot{X}$ = 115.54) and postingual deafness ($\dot{X}$ = 116.32) towards biology. There was a significant but negative difference between the attitude towards biology among the prelingually and postlingually deaf learners (t = -0.24; df = 39; $p < 0.05$). This implies that, even with the different times of onset of deafness, the perceptions and attitudes of deaf learners are not positively influenced by their onset of deafness. Also, Table 5(2) shows no difference in the attitudes of deaf male learners ($\dot{X}$ = 119.22) and that of their female counterparts ($\dot{X}$ = 112.06) towards biology. The differences in terms of gender and attitude towards biology was found to be insignificant (t = 0.310; df = 39; $p > 0.05$). This implies that gender differences have no impact on the attitude of deaf learners towards biology.

Discussion of Findings

Behavioural change is an attribute that distinguishes humans. While change in behaviour can be noticed by others, learning and attitude towards learning resources have been reported to influence learning. In this study we observed that deaf learners had the right attitude towards biology and that academic self-efficacy contributed to the positive significant attitude towards biology among the deaf participants. This finding corroborates the assertion of Bandura (1997), Erdem (2015), Woolcock et al. (2016), and Zhu et al. (2011) who assert that self-efficacy influences an individual's ability or potential to perform and complete a task. This means that the domain of self-efficacy among deaf biology learners influenced their reported attitude towards the subject. This quantitative report is in agreement with the findings of Gopal et al. (2018), Kundu and Ghose (2016), Stramel (2010), and Usher (2009) who all stress the importance of academic self-efficacy on the attitude of learners towards different science-related subjects. While we identified a relationship between academic self-efficacy and attitude towards biology among the deaf, Gopal et al. (2018) note a positive relationship between learners' engagement in statistics and attitudes towards statistics and academic self-efficacy. In the same vein, while measuring the attitudes towards mathematics, Kundu and Ghose (2016) found that academic self-efficacy was highly significant with regard to attitudes towards mathematics.

We found a significant but negative relationship between gender and attitude of deaf learners towards biology. In other words, gender does influence deaf learners' attitudes towards biology. The results from our study show that there is an inverse relationship between gender and deaf learners' attitudes towards biology. This finding does not agree with that of Greenfield (1997) and Nasr and Asghar (2011), who reported no correlation between gender and learners' attitudes towards sciences. However, our finding is in line with that of Amelink (2009), who notes that gender influences the choice of participation in biology. Dosanjh (2015) also avers that learners' attitudes towards life sciences is mainly influenced by gender. In terms of the onset of deafness, we found that, irrespective of the onset of deafness, the effects of the condition on learners' disposition towards biology was alike. Therefore, whether the case is prelingual deafness or postlingual deafness, deaf learners' attitude towards biology is not different. This finding differs from the view by Bakare (2013) that the dispositions of individuals who are deaf are different based on how they perceive and react to phenomena. In this regard, postlingually deaf learners tend to have a positive or better disposition towards education than their prelingually deaf peers. Conversely, the results from our study agree with those of Polat (2003) who avers that the age of the onset of deafness remains a powerful tool for behavioural change. This implies that attitudes towards various concepts tend to change.

We observed a minimal significant but negative difference between the attitudes of prelingually and postlingually deaf learners towards biology. This implies that the onset of deafness did not positively influence deaf biology learners' perceptions and attitudes towards biology. Andrews, Shaw and Lomas (2011) are of the opinion that children with acquired deafness or congenital syndromes both share cognitive, neurological, learning, emotional, and language characteristics, which can affect their development and school achievement. Gormally (2017) notes that no matter the attribute displayed by learners, especially those who are deaf, to be successful in science learning, they must develop attitudes to

support future engagements with challenging social issues related to science. Ogundiran and Olaosun (2013) report no significant difference in the mathematics performance of learners with congenital deafness and those with acquired deafness. They further note that language and communication difficulties, inattention and distractibility are factors that influence the attitudes of deaf learners.

Furthermore, we found no significant difference in the attitudes of male and female deaf learners towards biology. This implies that gender differences have no impact on the attitudes of deaf learners towards biology. This observation is not in agreement with the studies of Jones et al. (2000), Prokop et al. (2007), Uitto (2014), Usak et al. (2009) and Yorganci (2017), who all report differences in the attitudes of learners towards different subjects. Simonneaux et al. (2005) found that male learners were more favourably disposed towards scientific instruction than their female counterparts, but Prokop et al. (2007) and Usak et al. (2009) suggest that biology is more popular among girls. Jones et al. (2000) revealed that girls were more positive towards biology, while boys were more positive toward physics and chemistry. According to Uitto (2014) girls preferred biology and boys preferred physics as school subjects and both of them considered these subjects as suitable for their career plans. Yorganci (2017) also found that gender differences existed in learners' attitudes with male learners having more positive perspectives towards the use of mobile learning than female learners.

Conclusion and Recommendations

In this study the academic strengths and disposition of deaf learners towards biology were brought to the fore. We provide evidence-based findings on the attitudes of deaf learners in relation to gender, academic self-efficacy and onset of deafness. We conclude that gender has limited influence on the attitudes of deaf learners towards biology, while the onset of deafness (prelingual or postlingual deafness) has no obvious impact on deaf learners' attitudes towards biology. In other words, deaf learners experience language difficulties and their attitudes towards science-related subjects can be shadowed by their disposition towards activities in biology classrooms or laboratories. Importantly, we conclude that academic self-efficacy is an essential component that shapes the attitudes of deaf learners towards biology.

In view of the foregoing, we recommend the following:

- Deaf learners should be exposed to science concepts early in their preschool years. This will enable them to develop the right attitudes towards science concepts, particularly biology.
- Biology teachers and school administrators should ensure that biological concepts and terms are colourfully displayed in and around the biology classrooms and laboratories.
- Biology teachers should be creative in their teaching to further motivate deaf learners to actively participate in biology teaching and learning activities.
- School psychologists should place more emphasis on building academic self-efficacy of deaf learners, while parents of the deaf learners should be encouraged to motivate their children to engage in science activities.
- Government at all levels should create effective educational policies for science education for deaf learners. Collaboration with experienced sign language interpreters should be instituted to ensure that sign language for biology concepts can be developed for use among deaf learners in science classrooms.

Authors' Contributions

OTA wrote the manuscript and provided and analysed data for Table 1. DRN conducted the editing of the literature review. All authors reviewed the final manuscript.

Notes

i. Published under a Creative Commons Attribution Licence.
ii. DATES: Received: 20 July 2019; Revised: 23 February 2020; Accepted: 9 April 2020; Published: 31 May 2021.

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