



LEARNING OUTCOMES ON LINES OF LATITUDE AND LONGITUDE AMONG THE D.EL.ED TRAINEE –CONSTRUCTIVIST EXPERIMENT BASED ON VISUAL IMPAIRMENT

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Abstract: The Constructivist experiment is based on problem solving method involving 50 Trainees of District Institute of Education and Training, Mon, Nagaland. The aim is to evaluate the learning outcome on lines of latitude and longitudes replicating the visual impairment with low cost tactile material. The trainees were given 20 questions and the data were analyzed by using the Test of Homogeneity of Variances and ANOVAs. The results reveals that Agree and strongly agree data sets indicate higher values as compared to strongly disagree, disagree and neither agree nor disagree. One important characteristics in strongly agree about the data sets is that higher values are reported from knowledge and understanding as compared to application and skills. Whereas agree data sets reveals higher values in application and skills as compared to knowledge and understanding. The data set shows that there is a significance difference between the variables by using Test of Homogeneity of Variances and ANOVAs. It can be observed that learning outcome has been achieved by the trainees.

Keywords: Learning outcome, Visual, Latitude, Longitude, Agree, Strongly agree

1. INTRODUCTION

Learning outcomes are an essential part of the curriculum in the academic field. A learning outcome is “A statement of what a learner is expected to know, understand or be able to demonstrate at the end of a period of learning” (Credit and The Qualifications in England, Wales and Northern Ireland, 2001). Learning outcomes on latitude and longitude based on constructivist approaches is relevant. This approach enhances learning new thing by creating a classroom environment that emphasizes on collaboration and sharing of ideas. It enhances the visual impairment students in different type of work ranging from learning concept to skill related work. It has significant potential advantages for visual impairment learners through collaboration of work using different tactile learning materials, type of the methods and list of the techniques used. Visual impairment students can demonstrate competency in doing the work through constructivist approach and will exhibit enhanced skills in working with people with or with no impairment. In the recent decade, modern technologies have made the work easier for visual impairment students through the use of Computer Assisted Learning, GIS, Remote Sensing Software and Global positioning system etc. With the help of these technologies, visual impairment students will know latitude and longitude easily which will help to identify or locate the places on the Earth's surface. Facilitators should encourage and mould the visually impairment students to do their best to discuss with them and help them and to harness these abilities with which they know. The experience of having a visually impaired student learning about latitude and longitude in a constructivist classroom can inspire staff and fully sighted students too.

WHO (2022) reported that 2.2 billion people have a near or distance vision impairment worldwide. Currently, there are an estimated 4.95 million blind persons and 70 million vision impaired persons in India (Mannava *et al.*, 2022). According to the 76th round of the NSO survey conducted between July and December 2018, the percentage of male and female visual impairment is 0.1 and 0.3 respectively to total PWD in Nagaland (Kanwal, 2022). Many researchers in India and around the world have investigated on visual impairment focused on different learning material whether it is manual based, electronic or assisted technologies. However, this study is carried out based on low cost tactile materials focused on teacher trainer who are not exposed to any sort of training.

2. LITERATURE REVIEW

About 2.2 billion people have vision impairment out of which 11.5% (253 million people) are severely visually impaired or blind (VIB) (Bourne *et al.*, 2020; WHO, 2022). Special education minimizes the problems faced by people with disabilities for learning. Individual instruction, teachers and schools aligned the curriculum and lesson plans for each student based on their disabilities (Lemons *et al.*, 2018; Kirjavainen, *et al.*, 2016). Kapur (2017) studied on adaptive teaching methods for students with visual impairments, challenges experienced by students and teachers etc. Use of creativity can be found among the teachers with Special education who teaches mathematics and science etc (Fernandes *et al.*, 2021; Gucyeter and Erdogan, 2020) however, its often limited in providing new education materials to the students (Mejía *et al.*, 2021; Wongkia *et al.*, 2012). There is difficulty in creating specialty materials as well as lack of training in the use of technology for teaching VIB students (Flanagan *et al.*, 2013; Russo-Campisi, 2017; Riccomini *et al.*, 2017).

A tactile map is very important for the visually impaired people (Shull and Damain, 2015; Zeng and Weber, 2011), especially with the one having audio and vibration features (Brock *et al.*, 2015). A tactile map developed using haptic perception through the sense of touch to know the surroundings (Shull and Damain, 2015). The interactive system that combines vibrations and hearing is more effective in non-visual navigation (Geronazzo *et al.*, 2015). Audio tactile map prototype as a pre-navigation tool for visually impaired people to find out a new neighborhood (Favier and Van Der Schee, 2014). (Zeng and Weber, 2011) develop an interactive digital map where output in the form of audio depends upon by the users. An Interactive digital map using a tablet vibrates when the object is touched Papadopoulos *et al.*, (2018), It can be a navigator that can give information about a particular object or environment (Campus *et al.*, 2012). Accessible of visual map (Paladugu *et al.*, 2010) and exploration, identification of borders within or outside of the map were studied (Buzzi *et al.*, 2011). Ability to give different intensity of vibration to inform on a specific area for each map was investigated by Buzzi *et al.*, (2011). Congenitally blind need more time to identify the object and rely more on the braille labels compared to students who became blind at a later age. (See and Advincula, 2021). Feucht and Holmgren (2018) identified features that result in high degrees of readability and efficacy of tactile maps and suggested that it should be available in a variety of media.

Technology can help visual impairments in understanding an area with the help of sound and vibration support features in the map application for visual impairments (Muhammad Erwin Amrullah *et al.*, 2022). Smart phones and wearable with built-in cameras allows for positioning and monitoring of the user's surrounding area for navigation (Real and Araujo, 2019. Anke *et al.*, (2014), reveals that replacing braille with simple audio-tactile interaction significantly improved efficiency and user satisfaction. Interactive multimedia tactile maps add audio and voice commentary and tactile features (Siekierska *et al.*, 2003). Tactile graphs are appropriate so that blind people can quickly understand (Watanabe *et al.*, 2012). 'TacTalk' or 'talking tactile map' incorporated with audio support benefit the visually impaired to travel alone (Minhat *et al.*, 2020). (Rowell and Ungar, 2003) mentioned that swell paper and thermoform are the two most popular methods to produce tactile maps. Experiments was taken to investigate distinguishable lines and symbols in design processes a results of limited haptic sensitivity of fingers (Jehoel *et al.*, 2006); (McCallum *et al.*, 2006); Lobben and Lawrence, 2012). From map images to create tactile street maps (Wang *et al.*, 2009), users can explore the maps with their fingers, and obtain more detailed information with the help of auditory representation (Wang *et al.*, 2009; Miele, 2006). (Zeng and Weber, 2010) developed an audio-haptic map system in which a set of tactile symbols is employed to represent points of interest and several manners to explore maps. (Albouys-Perrois *et al.*, 2018) designed and developed an augmented reality map that combines projection, audio output and use of tactile tokens. Tactile maps should be available to students in all the formats (Gual *et al.*, 2013); (Gual *et al.*, 2015). Touch screens, vibration feedback, auditory, vibro tactile or braille, are some of the things that make visual map accessible for visually impaired (Buzzi *et al.*, 2011). To utilize the haptic perception system via the sense of touch Maps with tactile components can be integrated with the help of technology (O'Sullivan *et al.*, 2015). It is observed that annotated tactile maps for pre-navigation have positive response from the participants (Zeng and Weber, 2011). Video game pre-navigation approaches (Marebet *et al.*, 2012), accessible interactive maps (Ducasse *et al.*, 2018), interactive hepatic maps on tablet/mobile devices (Papadopoulos *et al.*, 2018), the use of Bluetooth, wireless, and GPS technology (Martinez-Sala *et al.*, 2015; Meliones and Sampson, 2018) have been developed. It is observed that interactive approaches is better than conventional methods (Brayda *et al.*, 2018; Marebet *et al.*, 2012; Martinez-Sala *et al.*, 2015; Meliones and Sampson, 2018) with regard to learning, navigation, orientation, and recall. Papadopoulos *et al.*, (2018) identified that audio-tactile maps using tablet devices which are effective than a verbal description of the journey.

The experimental condition had significantly better than the control group and suggested that the interactive component offered individuals the freedom to learn the map in several ways and did not restrict them to a sequential and linear approach to learn (Griffin *et al.*, 2020). Experiment was conducted to predict frequency based on longitude, latitude and the accuracy of each experiment predict above 90% or a value of 0.90, suggesting that convenient experience for the visually impaired population (Liang *et al.*, 2021)

3. PROBLEM STATEMENT

In Nagaland, it has been seven years since the introduction of new syllabus based on constructivism under State Board of Teacher Education, Nagaland in line with NCERT (National Council for Educational Research and Training) and NCTE (National Council for Teacher Education). For this experiment, Mon DIET (26° 69'92'' N and 95°03'10''E) was chosen as this is the only teacher training institute in the whole district. As of now there are no separate papers on special education in D.EL.ED curriculum (SCERT) that can train the D.EL.ED trainee in the State of Nagaland. So even after completing two year D.EL.ED course they leave without learning the basic practical knowledge. So in future it is difficult for them to teach in an inclusive environment. Further, University Grants Commission (UGC) has directed its affiliated colleges and universities to integrate suitable educational resources and infrastructure for visually impaired students. Therefore, classroom should be more inclusive as well as the curriculum. NEP (2020) also stated about inclusive and equitable quality education and promotes lifelong learning opportunities for all by 2030. Hence, it is relevant to know the basic things for a teacher trainer to teach in an inclusive classroom.

The purpose of this study is to evaluate the learning outcome on important lines of latitude and longitude from knowing the basic things; understanding the concept to application and skills. For this experiment, the topic "The Earth – Our planet" (Class 5 Social Studies

text book) was chosen based on the sub-topic: Latitude and Longitude published by SCERT (State Centre for Educational Research and Training), Nagaland. In the light of the above discussions, 50 trainees were selected formed into 25 group members to investigate the learning outcome based on the use of low cost tactile material.

To the best of our knowledge and review of the earlier research work, no work of this study has ever been carried out among the D.EL.ED trainee in the state of Nagaland. It is based on the above that this study wish to do the experiment among the D.EL.ED trainee on visual impairment with low cost tactile teaching learning material in District Institute of Education and Training, Mon, Nagaland.

4. METHODOLOGY

4.1: Materials

The materials use for this experiment consists of old chart paper, old files and hard paper cover. For preparing the outline base map (globe), the paper is cut into oval shape. For all the latitude (Equator, Tropic of Cancer and Tropic of Capricorn, Arctic Circle, Antarctic Circle and the poles) and longitude (prime meridian), the shape is rectangular in nature. The length and breadth of the tactile materials' are shown in the Table 1

Table 4.1: Length and breadth of the tactile materials

S.N	Title	Length	Breath	Quantity
1.	Globe	34 cm	18 cm	25
2	0° (Equator)	34 cm	0.5 cm	25
3	23 ½° N & S (Tropic of Cancer & Tropic of Capricorn)	10 cm	0.5 cm	50
4	66 ½° (Arctic circle & Antarctic circle)	8 cm	0.5 cm	50
5	90° (North and South pole)	Marking	Marking	50
6	0° (Prime meridian)	18 cm	0.5 cm	25

4.2: EXPERIMENT

The experiment is based on problem solving method. Techniques used in this experiments are; Identifying, classifying and critical thinking. There are four facilitators (one lecturer and three ministerial staff) to administer the students. The experiment in this study involved 50 Trainees forming 25 group members studying in D.EL.ED first year of DIET, Mon, Nagaland. Before the experiment begins, the trainees were brief on the procedure of the work and were asked to cover their eyes by the scarf so that it will be difficult for them to see. The trainees need to replicate the life of visual impairment students. Instruction was given to them about the phase wise of the work. For this experiment, constructivist approach developed by Bybee *et al.*, (2006) based on 5 E Models was used.

Engage - Teacher begins the class by allowing them to listen to the audio clip about the globe and asks them to listen and describe (YouTube: Earth 101 National Geographic).

Explore - The teacher give proper instruction before stating the work. The teacher instructed the students to do the experiment according to the step wise. The materials consist of oval shape low cost chart paper which is 15 cm in length and 10 cm in breath along with that glue stick pencil, scale and scissor.



Figure 1: Oval shape (Globe)
*PM: Prime meridian



Figure 2: Latitude (0°, 23½°, 66½°)



Figure 3: Longitude (0° PM*)

First step: A4 size paper (oval shape) will be given. By touching, ask them to fold into two where the longest line will form. Further away from the folded place, ask them to fold again where two more lines will form on both the sides.



Figure 4: First step (0°)
*N & S: North and South



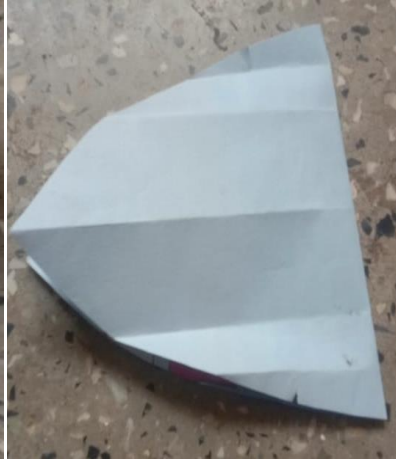
Second step ($23\frac{1}{2}^\circ$ N&S*)



Third step ($66\frac{1}{2}^\circ$ N&S)



Fourth step (0° L*; PM)
*L: Longitude



Fifth step (0° L*; PM)



Last step (Final shape)

Second step: They were given 6 rectangular strips of paper with different length. Ask them to paste in all the places where it folded according to the length (Figure 5).



Figure 5: Pasting (Latitude/longitude)

Third step: Ask them to paste on the line where it folded on the reverse line where they have folded already (Figure 6).

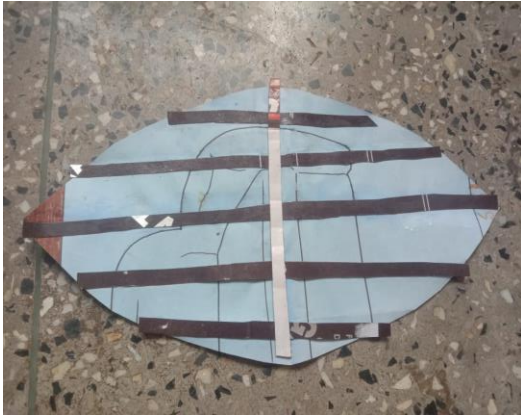


Figure 6: Pasted Latitudes and longitude

Fourth step: Further, the teacher ask them to indicate (responding orally) - East, West, North and South .

Explain - The teacher asks the students to name the lines of latitude and longitude and four parts of the earth (Northern Hemisphere, Southern Hemisphere, Eastern Hemisphere and Western Hemisphere) in the globe.

Elaborate - The teacher will elaborate certain points that require further clarifications. To help students elaborate their understanding, questions will be asked to all the groups. Teachers ask the students to locate places by indicating (orally) - 0° , $23\frac{1}{2}^\circ$, $66\frac{1}{2}^\circ$ on both the sides and on the top and bottom by 90° . Instructed them to indicate 0° (orally) where it folds into two parts of the reverse line.

Evaluate – Hard paper cover were distributed to 25 group members. The teacher evaluates their learning by instructing the entire 25 group to cut the shape of the globe with the help of the scissors.



Figure 7: Cutting the shape of the globe



Figure 8: Shape of the globe

4.3: DATA

To test the success of the aim and objectives of the given task, the experiment was conducted in the first stage followed by the questionnaire. After the experiment, the trainees were given 20 questions with different levels of questions ranging from knowledge to skills based on 5 point Likert Scale (Agreement). The data were collected and analyzed with the help of simple statistical methods. SPSS software was used to find out Test of Homogeneity of Variances and ANOVAs and graphical representations were drawn with the help of Microsoft excel.

5. RESULT AND DISCUSSION

In order to find out the variation among the variables (Strongly disagree, Disagree, Neither agree nor disagree, Agree and Strongly agree) based on 20 questions, percentage are worked out. The results obtained are reported in Table 2.

Table 2: Percentage wise response based on twenty questions

1. The earth is irregularly shaped ellipsoid					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Total
0%	8%	17%	27%	48%	100
2. Tactile material are used for the blind persons for Teaching and learning					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	0%	4%	36%	60%	100
3. The lines that runs from East to West is called latitude					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	4%	2%	21%	73%	100
4. The lines that runs from North to South is called Longitude					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	2%	6%	17%	75%	100
5. The lines of latitude and longitude for this experiment is differentiated by the size of the materials					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
17%	27%	8%	25%	23%	100
6. There are four hemisphere – Northern and Southern hemisphere; Eastern and Western hemisphere					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	0%	0%	29%	71%	100
7. Northern and Southern hemisphere is divided by a straight line called equator					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
8%	4%	11%	21%	56%	100
8. India is located in the Northern hemisphere					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
2%	0%	2%	23%	73%	100
9. Eastern and western hemisphere is divided by prime meridian					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
2%	4%	6%	25%	63%	100
10. Equator is hot while the pole is cold					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	0%	4%	42%	54%	100
11. Can place the Map of India in the Northern Hemisphere					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0	6%	10%	38%	46%	100
12. Can paste the lines of latitude and longitude in proper place					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
6%	2%	10%	67%	15%	100
13. Can mark the all the important degrees of latitude and longitude					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	13%	10%	58%	19%	100
14. Can locate the lines of latitude and longitude depend upon the length					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	2%	10%	71%	17%	100
15. Can locate the cardinal points (North, South, East and West) on the globe					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
7%	0%	6%	56%	31%	100
16. Can cut the shape of the earth (hard paper cover) with the help of scissors					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
2%	4%	11%	48%	35%	100
17. Can cut the line of latitudes and longitude with the help of scissors					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	8%	2%	73%	17%	100
18. Can mark the line of latitudes and longitude by folding the paper					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	6%	0%	54%	40%	100
19. Can place the degrees of latitude and longitude in proper place					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	
0%	8%	25%	44%	23%	100
20. Can mark the equator and prime meridian by folding the paper					
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	

0%	6%	4%	56%	34%	100
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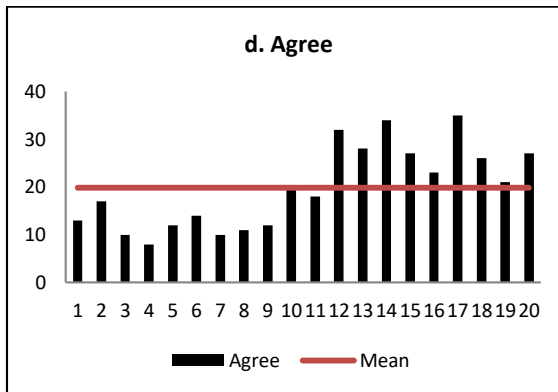
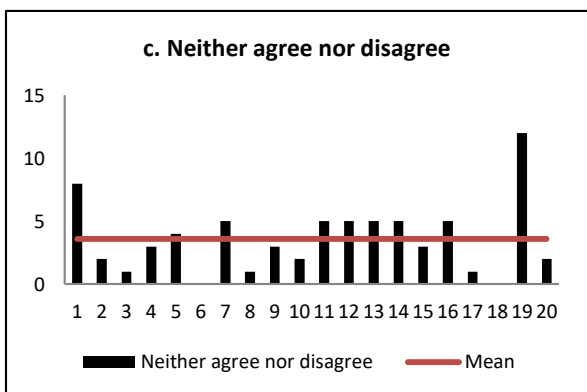
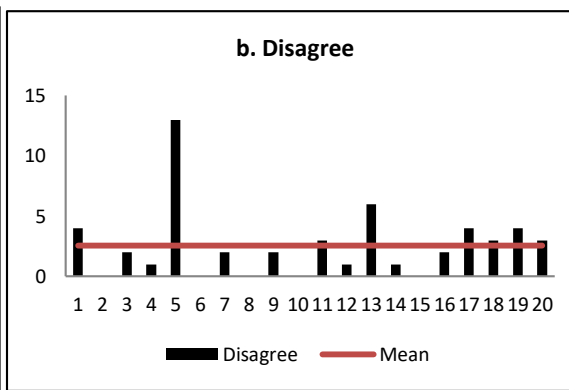
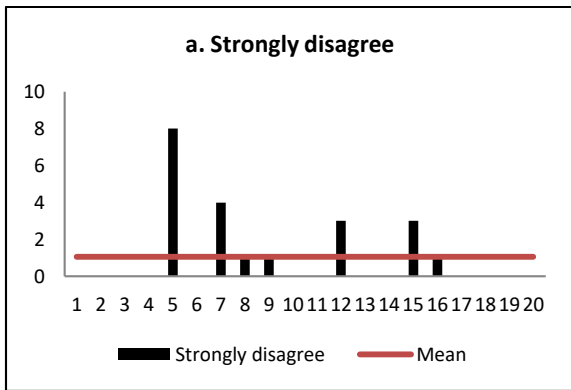
Table (2) shows that 48% of the trainees strongly agreed that the earth is irregularly shaped ellipsoid. There is also a variation among the variables varying from 8% (disagree), 17% (Neither agree nor disagree) to 27% (agree). It is also observed that 60% of them strongly agree that tactile materials are used for blind person for teaching and learning. Among the trainee, 73% of them strongly agreed that the line that runs from east to west is called latitude and 75% of them strongly agreed that the line that runs from North to South is called longitude.

The table also show that variation are more when the lines of latitude and longitude for the experiment is differentiated by the size of the materials - strongly disagree (17%), disagree (27%), Neither agree nor disagree (8%), agree (25%) and strongly agree (23%). More than 71% of the trainee stated strongly agreed that there are 4 hemispheres - Northern, Southern, Eastern and Western. It is also reported that 56% strongly agreed that that Northern and Southern hemisphere is divided by a straight line called equator. 73% of the trainees strongly agree that India is in the Northern hemisphere. 63% strongly agreed that eastern and western hemisphere is divided by prime meridian while 42% and 54% (agree and strongly agree) responded that equator is hot while the pole is cold.

There is a variation between the variables (disagree 6%, neither agree nor disagree 10%, agree 38% and strongly agree 46%) where to place the map of India in the Northern hemisphere. It also observed that the 67% of the trainee agreed that they can paste the line of latitude and longitude in proper places. 58% agreed that they can mark all the important lines of latitude and longitude. While 71% agreed that they can locate the lines of latitude and longitude depend upon the length. It is also observed that 56% of them agreed that they can locate the cardinal points on the globe.

Further, the table also show that there is a variation among the trainee how to cut the shape of the earth where it is 2% for Strongly Disagree, 4% for disagree, 11% for Neither agree nor disagree, 48% for agree and 35% for strongly agree. And at least 73% and 40% of the trainee shows that (agree/Strongly agree) they can mark the lines of latitude and longitude by folding the chart papers. There is also a variations in placing the degree of latitude and longitude in proper place where it is 8% for disagree, 25% for neither agree nor disagree, 44% for agree and 23 for strongly agree. Finally, the trainee can mark the equator and prime meridian by folding the papers where it is 56% (agree) and 34% (strongly agree) respectively.

It can be noted that higher values are on the right side than on the left side of the table which conclude that majority of the respondent have understood the concept positively and can do the work with the help of tactile materials.



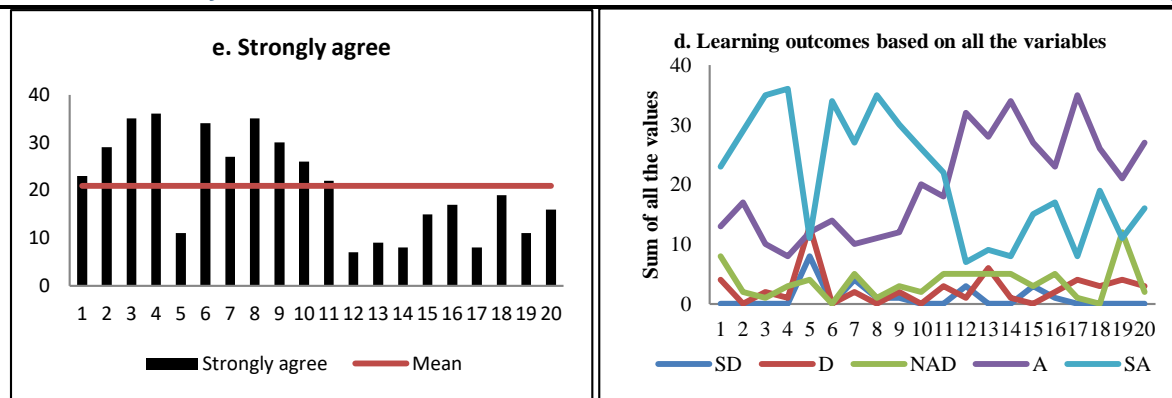


Figure 9 (a-d): Sum of values of all the variables based on all the twenty questions

The above figure 9 (a-c) depicts that lower values are reported among the variables viz., strongly disagree, disagree and neither agree nor disagree and also it is scattered. The values range from 1 to 13. It is also observed that higher values are reported from strongly agree and agree. Further, it is also observed that in agree, higher values can be seen from the questions based on concept as compared to the questions related to skills. The reverse trend can be seen from strongly agree. Hence, it can be concluded that (Figure 10 d) higher values are on the positive side (strongly agree and agree) while lesser values are on the negative side (Strongly disagree and disagree).

Statistical tests are a way of mathematically determining whether two sets of data are significantly different from each other. So to test its significance, all the values are sum up according to the respective variables (Strongly disagree, disagree, neither agree nor disagree, agree and strongly agree) and computed by using the Test of homogeneity of variance (Levene statistic) and ANOVAs.

Table 3. Test of Homogeneity of Variances

VAR00001			
Levene Statistic	df1	df2	Sig.
2.502 ^a	16	67	.005

a. Groups with only one case are ignored in computing the test of homogeneity of variance for VAR00001.

If the p-value for the Levene test is greater than .05, then the variances are not significantly different from each other (i.e., the homogeneity assumption of the variance is met). If the p-value for the Levene's test is less than .05, then there is a significant difference between the variances. The result shows that there is significant difference between the mean among the variables.

Table 4: ANOVAs

VAR00001					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	158.594	32	4.956	8.020	.000
Within Groups	41.406	67	.618		
Total	200.000	99			

Further, ANOVA (Analysis of Variance) was used to find out the difference between the means of more than two groups. One-way ANOVAs determine how one factor impacts another. It determines the impact of one or more factors by comparing the means of different samples. The result reveals that there is a significant difference between the groups.

6. CONCLUSION

In conclusion, the following significant points can be listed based on the discussions in the earlier paragraphs. Agree and strongly agree data sets reveal higher values as compared to strongly disagree, disagree and neither agree nor disagree. One important characteristics in strongly agree about the data sets is that higher values are reported from knowledge and understanding as compared to application and skills. Whereas agree data sets reveals higher values in application and skills as compared to knowledge and understanding. The data sets reveal that there is a significance difference between the variables by using Test of Homogeneity of Variances and ANOVAs. Finally, it can be observed that learning outcome has been achieved by the trainees. It can be stated that this is the first time that an experiment has been carried out on learning outcome in the institute based on visual impairment. It is observed that theoretical and practical aspect of the work was positive. It is quite difficult to conduct experiment on constructivism among the visual impairment however with the help of the four facilitators the work was executed well. This approach was succeeded further due to the close collaboration and pairing of the team. Low cost tactile materials which they use for the first time could be handled by the trainee well. It is also observed that visual impairment students can demonstrate competency in doing the work well. Hence, it can be concluded that there is a positive impact in learning outcomes on important lines of latitude and longitude among the D.EL.ED trainee based on visual impairment.

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