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Research Article

Study on distribution of fingerprint patterns - A novel experiment for school students

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Abstract

Innovative science experiments have the potential to build up passion in learning science, develop creativity, problem solving ability, psychomotor skills, and scientific attitude and train them in scientific method. In this context, the present paper is made with two objectives viz. 1. to design and propose an innovative experiment (for class IX-XII) on distribution of patterns of fingerprint among classmates (Part A) and 2. to find out the distribution of patterns of fingerprint of school teachers in relation to gender and blood group (Part B). A fingerprint is an impression left by the friction ridges of a human finger and is genotypically determined, unique and remains unchanged from birth till death. Fingerprints have three basic patterns viz. loops, whorls and arches, however, seven different patterns can be observed. Fingerprints are not only used for identification of person but also for other purposes.

In part A we designed and proposed an innovative and no-cost experiment for the students of class IX-XII to study the distribution of pattern of fingerprints among their classmates; and suggested many ideas for further extension of the study. In part B, we have studied the pattern of left thumbprint of school teachers (N=50; M=20 and F=30) from Atomic Energy Central School (AECS) and Demonstration Multipurpose School (DMS), Mysore. From the results of our model study, it may be concluded that, overall or gender based or blood group-wise comparison indicates loop is the dominant and mixed/ composite is the least pattern of thumbprint among teachers. There exists a gender based difference in pattern. Further, we sincerely believe and propose that, this study of fingerprint can be used as an innovative, effective and low-cost experiment at secondary and higher secondary (IX – XII) classes; and this view is acknowledged / accepted by most of the teachers of ACES and DMS, Mysore.

Keywords : Fingerprint, school teachers, blood group, creativity, problem solving ability, psychomotor and Mysore.

Introduction

Emerging new trends in Science Education lay emphasis on quality rather quantity which affects the very texture of classroom teaching. Teaching of Science offers students the ability to access a wealth of knowledge which will contribute to an overall understanding of how and why things work like they do and also helps them to take a well-informed decision. In view of the fact that engaging the enthusiasm of the students in Science class is pivotal, innovative science experiments have the potential to build up enthusiasm and commitment of students in learning science. Novel experiments also develop creativity, problem solving ability, psychomotor skills, and scientific attitude and train them in scientific method. In this context, present paper was made with two objectives viz. 1. to design and propose an innovative experiment (for class IX-XII) on the distribution of patterns of fingerprint

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among classmates (Part A) and 2. to find out the distribution of patterns of fingerprint of school teachers in relation to gender and blood group (Part B).

Biology of fingerprint : A fingerprint is an impression left by the friction ridges of a human finger. A friction ridge is a raised portion of the epidermis on the digits (fingers and toes), the palm of the hand or the sole of the foot, consisting of one or more connected ridge units of friction ridge skin. Fingerprint patterns are genotypically determined and remain unchanged from birth till death (Eboh, 2013). Every major event between week 6 and week 21 of fetal life leaves its mark in unique three basic patterns of fingerprints i.e. loops, whorls and arches. The worldwide percentage distribution of loops, whorls, arches and composite is approximately 65%, 25%, 7% and 2-3% respectively (Nandy, 2001). Distributions of fingerprint patterns are similar on both hands in both sexes (Tanuj and Saurabh, 2006). These fingerprint patterns correlate to the amount of hormones, environmental factors and nutrients that were exposed to in utero and the decisions that our genes made for our developing body. Fingerprints are easily deposited on suitable surfaces by the natural secretions of sweat from the exocrine glands that are present in epidermal ridges.

Principles of fingerprint : Fingerprints follow three fundamental principles: 1. a fingerprint is an individual characteristic, i.e. the number of lines, their shapes or size makes every fingerprint unique; 2. a fingerprint pattern will remain unchanged for the life of an individual and; 3. fingerprints have general characteristic ridge patterns that allow them to be systematically identified (Dactyloscopy).

Basic patterns of fingerprint : Fingerprints have three basic patterns viz. loops, whorls and arches, however, seven different patterns can be observed as shown in figure 1. Each pattern has unique features as follows:

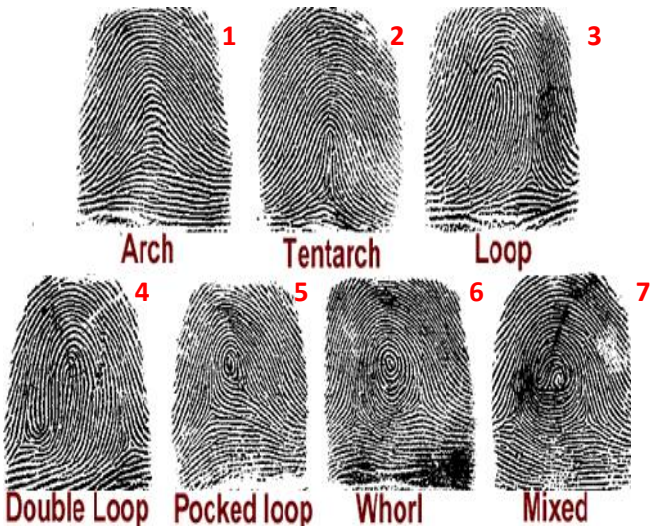

Fig.-1. Patterns of finger print

Source: http: //www.odec.ca /projects /2004 /mcgo4s0/public_html/t5/fingerprints.html

Arch: Lines are going like waves from one side to the other side.

Tentarch: Like arch, but with a rising stick in the middle.

Loop: Lines coming from one side returning in the middle to the same side.

Double loop: Like loop, but with two loops inside, one standing and one is hanging.

Pocket loop: Like loop, but with small circle in the turning point.

Whorl: Lines are making a circle and has two deltas.

Mixed: Composed of two or three basic types.

Past studies on fingerprint: Studies were conducted in the past to establish a relationship between gender and fingerprint ridge density (Sudesh, 2007; Ritu *et al.,* 2012; Karki and Singh 2014). Fingerprints are not only used for identification of a person or gender but, also for other purposes. For example association of finger- print patterns with diseases of genetic origin like congenital talipes (Kulkarni *et al.,* 2006) and also pulmonary tuberculosis (Babu *et al*., 2005) have been reported in the past. Sontakke *et al*. (2010) found significantly increased whorls and

decreased loops in klinefelter's syndrome patients as compared to the controls. Mario *et al.* (2011) studied the fingerprint patterns in children with acute lymphoblastic leukemia (ALL) and found a possible trend and an association of finger print patterns with ALL. Further, tests based on Dermatoglyphics can reveal our intrinsic qualities and talents, enhance learning experiences by identifying learning styles, personalise academic and extracurricular programs, reveal hidden talents, build confidence and make academic and career choices easier (Ismat, 2012). This method is based on the scientific premise that the patterns on one's fingertips are in synchronized with the patterns on an individual's left and right brain.

Materials and Methods

The materials such as Ink pad, white sheet (bond, A4), magnifying lens, scale, pencil and cleaning cloth were used with the following procedure

1. Take a few A4 white sheets and draw 16 small boxes of 4 rows and 4 columns on one side.

2. Give running number to each box which is measuring about 7cm height and 5 cm width. Each box has an upper fingerprint area (5cm height) and lower personal detail area (2cm ht).

3. With the permission of the class teacher collect the fingerprint (left thumb) in the following manner :

a. Ask your classmates to wash and dry their hands.
b. Call them one by one on roll number-wise and ask to gently press their left thumb on an ink pad up to the distal horizontal line.
c. Immediately get the print of the thumb by a gentle press in the fingerprint area of the box in the sheet and ask them to clean their thumb with cleaning cloth.
d. If the fingerprints are not clear get one more clear print by the side of it.

4. Write their name, gender and blood group in the personal detail area of the box (Fig.-2).

5. After collecting the thumbprint from all the classmates, identify and note its' pattern with the help of magnifying lens and by using above given patterns of fingerprint (Fig.-1).

6. Count the number / frequency of each pattern and find out the percentage of each pattern for the whole class.

7. Further, calculate the number and percentage of various patterns of fingerprint separately for the subgroups i.e. male and female, A, B, AB and O and Rh+ve and Rh-ve blood groups and tabulate (Table 1 - 4).

8. Observe the difference (in percentage) if any, and if possible use Chi-square and Student 't' test to find out the level of significance.

9. Make an effort to explain why the difference? (if any).

Following above procedure (of part A) the pattern of fingerprint i.e. left thumbprint of school teachers (N=50; M=20 and F=30) from Atomic Energy Central School (AECS) and Demonstration Multipurpose School (DMS), Mysore, was taken and analyzed.

Result and discussion

Though the study has the limitation of having less number of samples, it had shown the variation in percentage of various patterns of fingerprint among subgroups. Number/ frequency and percentage of various patterns of thumbprint of overall and different subgroup were calculated and compared in Table 1 to 4. It is observed from the Table 1 that loops (64%) were the predominant pattern of finger- print and mixed /composite (8%) was the least among the studied school teachers i.e. the subjects. Arch and whorl pattern were distributed equally with 14% each. Present observation is in correlation with the worldwide percentage distribution of loops, whorls, arches and mixed which are

Table - 1. Overall distribution of patterns of fingerprint among teachers

Sl. No	N	Arch				Loop						Whorl		Mixed	
		Arch (simple)		Tentarch		Loop (simple)		Double Loop		Pocket Loop					
		F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	50	6	12	1	2	27	54	3	6	2	4	7	14	4	8
		14%				64%						14%		8%	

N - Number, F - Frequency, % - Percentage.

Table - 2. Distribution of patterns of fingerprint in male and female teachers

Sl. No	Gender	N	Arch				Loop						Whorl		Mixed	
			Arch (simple)		Tent-arch		Loop (simple)		Double Loop		Pocket Loop					
			F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	M	20	4	20			7	35	1	5	2	10	3	15	3	15
			20%				50%						15%		15%	
2	F	30	2	7	1	3	20	67	2	7			4	13	1	3
			10%				74%						13%		3%	

N - Number, F - Frequency, % - Percentage, blank indicates nil value.

Table - 3. Distribution of pattern of fingerprint in A, B, AB and O blood groups of teachers

Sl No	Blood group	N	Arch				Loop						Whorl		Mixed	
			Arch (simple)		Tent-arch		Loop (simple)		Double Loop		Pocket Loop					
			F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	A	15	2	13			8	54					3	20	2	13
			13%				54%						20%		13%	
2	B	16	1	6			10	62	2	13	1	6	2	13		
			6%				81%						13%			
3	AB	Nil	Nil													
4	O	19	3	16	1	5	9	47	1	5	1	5	2	11	2	11
			21%				57%						11%		11%	

N - Number, F - Frequency, % - Percentage, blank indicates nil value.

Table - 4. Distribution of patterns of fingerprint in Rh+ve & Rh-ve blood groups of teachers

Sl. No	Rh group	N	Arch				Loop						Whorl		Mixed	
			Arch (simple)		Tent-arch		Loop (simple)		Double Loop		Pocket Loop					
			F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	Rh+ve	48	6	13	1	2	25	52	3	6	2	4	7	15	4	8
			15%				62%						15%		8%	
2	Rh-ve	2					2	100								
							100%									

N - Number, F - Frequency, % - Percentage, blank indicates nil value.

approximately 65%, 25%, 7% and 2-3% respectively (Nandy, 2001).

Table 2 shows the comparison of percentage distribution patterns of fingerprint between male (N=20) and female (N=30) and tells that the percentage of loop was higher in female (74%) than male (50%). Further, the percentage of arch was double in male (20%) than female (10%) and mixed typed was five times greater in male (15%) than female (3%). In contrast, Tanuj and Saurab (2006) and Eboh (2013) found no gender based difference in fingerprint pattern. It was also observed that both gender had higher incidence of loops than other types and this is in agreement with the report of Tanuj and Saurab (2006) whereas Karki and Singh (2014) disagreed by stating that males had higher whorls and females had higher loops.

In the case of blood group there was no AB group among the school teachers of the present study (N=50). It is evident from the table 3 that loops are the dominant pattern in all three (A, B and O) blood groups and especially it was higher in B (81%) than O (57%) and A (54%) blood groups (Table -3). In contrast, Amit *et al.* (2011) found highest loops (61.8%) in O and lowest in AB (47%) blood groups. The present study shows that arches were higher in O (21%) and lower in B (6%) and Kshirsagar *et al.* (2001) also reported a lower percentage of arches in the B blood group. Similarly, whorls were higher in A (20%) lower in O (11%) group which supports the result of Amit *et al*. (2011) that a higher percentage of whorl was found in B and lower in O group. On contrast Kshirsagar *et al*. (2001) reported higher whorls in the O blood group.

Out of total 50 subjects 48 were with Rh+ve and only 2 were found to be Rh-ve blood group. Among the Rh+ve subjects (Table - 4) loops were found higher (62%) and mixed was the lowest (8%), whereas, arch and whorl were found with equal percentage (15%). The only two Rh-ve subjects had only loops (100%). In support, Amit *et al.* (2011) and Kshirsagar *et al.* (2001) found that loops are dominant (54%) pattern among Rh+ve and Rh-ve subjects.

Suggested ideas for extension of the study

1. Similar study can be extended further to find out the pattern of fingerprints of a) left and right thumb, b) all ten fingers, c) all ten toes or d) even all toes, fingers and thumbs of classmates.
2. Further, it can also be extended to find out the difference in pattern among other subjects (volunteers) like teachers and non-teaching staffs, smokers and non-smokers, alcohol takers and non-alcohol takers, singers and non-singers, vegetarians and non-vegetarians etc.
3. Furthermore comparative study of finger-print patterns of different professionals like, doctors, nurses, engineers, teachers, drivers, police men, shop keepers, etc. can be made to find out whether there is any relation between finger- print pattern and profession.

Conclusion

From the present study it, may be concluded that, an overall or gender based or blood group-wise comparison indicates loop was the dominant and mixed/ composite was the least pattern of thumbprint among teachers. There exists a gender based difference in pattern, this study of fingerprint can be used as an innovative, effective and low-cost experiment at secondary and higher secondary (IX – XII) classes; and this view was acknowledged / accepted by most of the teachers of ACES and DMS, Mysore.

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