CHAPTER 3

METHOD


METHOD

3.1. Aim

The present study aimed to assess the relationship of VP, VMI, and handwriting with academic performance in elementary school children yearly from second to fourth standard with the following objectives.

3.2. Objectives

- To determine the relationship of VP, VMI, and handwriting with academic performance over a period of three-years, among elementary school children.
- To identify whether academic performance can be predicted using VP, VMI, and handwriting skills.
- To assess the yearly changes of VP, VMI, and handwriting over a period of three-years among a cohort of elementary school children.

3.3. Definition of Terms

- **Elementary School Children**: A school for children to study from second to the fourth standard.
- **Academic Performance**: “Evaluation of students’ expected performance on academic activities in the classroom” (Zitzmann, 2005).
- **Visual Perception**: It is referred as “the ability of the brain to understand and interpret or make sense of the sensory stimulus of what the eyes see and based on this understanding and interpretation, the person would be able to express the meaning verbally or motorically” (Gardner, 1992).
- **Visual Motor Integration**: “Ability to transform visually perceived objects to a motor output” (Tekok-Kilic, Elmastas-Dikec & Can, 2010).
- **Handwriting**: Refers to “writing with a pen or pencil” (Oxford dictionary, n.d.).
3.4. Operational definitions

- **Academic Performance:** the average scores obtained in mid-year and end of the academic year exams in English, Mathematics, Social sciences, Environmental Studies, Kannada/Hindi and scores obtained in teacher rating scale.

- **Visual Perception:** ability of a child to perceive different forms from simple to complex and interpret them.

- **Visual Motor Integration:** Ability of a child to copy various geometric forms from simple to complex with paper and pencil.

- **Handwriting:** Ability of a child to write letters, words and numerals legibly.

3.5. Study design

Children aged seven-years (7.0 years - 7.11 years), studying in the second standard at the time of recruitment were considered as a cohort and were followed up for three years.

3.6. Study participants

The study participants were children aged seven-years (7.0 years - 7.11 years) studying in second standard, from selected schools.

3.7. Sampling method

Convenience sampling method was used in the study to select schools. The investigator approached the Village Accountant and collected a list of schools in Shivalli village in the year 2013. There were five private, eight government aided and three government schools at Shivalli village in Udupi block, Udupi taluk, Udupi district of Karnataka state, India. Out of which, four private, eight government aided and three government schools gave permission to conduct the study. Information about the schools such as, the type of school, the medium of teaching, number of students, and
examination scheme was collected. Three of the government schools were excluded from the study as they did not have an exam scheme, which is required to measure the academic performance. The purpose of the study was explained to the school headmasters/ principals and the parents before the commencement of the study.

3.8. Ethical Clearance

Ethical approval was obtained from the Institutional Ethics Committee (IEC), Kasturba Hospital, Manipal (IEC 212/2013) (APPENDIX-2).

3.9. Sample size

The sample size was estimated based on academic performance among three categories (i.e. low, average and high) of VP in second standard using the comparison of two means formula with Bonferroni adjustment. The minimum clinical significance difference between any two groups was decided as 10, with standard deviation as 12, based on the pilot study (APPENDIX- 3) and previous literature (Dhingra et al., 2010). The sample size was determined to be 69 in each group for 80% power, 5% level of significance, considering design effect of 2 and attrition rate of 10% using the following formula:

\[ n = \frac{2 \left( Z_{1-\alpha/6} + Z_{1-\beta} \right)^2 S^2}{d^2} = \frac{2 \left( 2.39+0.84 \right)^2 12^2}{10^2} = 31 \]

The final sample size required in each group of VP for the design effect of 2 and dropout rate of 10% is 31 x 2 /0.9 = 69, which resulted in a total sample size of 207.

3.10. Recruitment of study participants

The list of second standard children with their dates of birth was collected from the selected schools. Children with age of seven studying in the second standard at the time of recruitment from the selected schools were included in the study.
3.11. Informed consent

The subject information sheet was provided to the parents of the sample children (APPENDIX-4). Details about the study such as objectives, procedure, compensation, risks, and benefits were explained to the parents in their primary language (English/Kannada). Parents who were willing to permit their children to participate in the study were provided with a consent form and a written consent was obtained in their language (APPENDIX-5). Children who willingly accepted to participate were only included in the study.

3.12. Selection criteria

After obtaining a written consent from their parents, study participants were selected based on the following inclusion and exclusion criteria.

3.12.1. Inclusion: Children of both genders from the second standard who matched the criteria for age were included in the study.

3.12.2. Exclusion: Children who had any physical defects, auditory defects, visual defects, intellectual ability score less than 90 in the standard score based on Raven’s Educational Colored Progressive Matrices, LD, clinical syndromes such as Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social problems, Thought problems, Attention Deficit/Hyperactivity problems, Rule-Breaking Behavior, and Aggressive Behavior as per Childhood Behavior Checklist- Teacher’s Report Form were excluded from the study.

3.13. Semi-structured interview

A semi-structured interview was conducted with parents and teachers to obtain demographic details such as, the type of family, preschool status, involvement in extra-curricular activities, peer interaction, regularity of attendance and parents’ educational qualifications, occupations, annual income and physical health status of their children.
3.14. Tools

The following tools were used in the current study for screening and to measure primary outcomes.

3.14.1. Kuppuswamy’s Socioeconomic Status Scale- Updating for 2007 (Kumar, Shekhar, Kumar & Kundu, 2007)

3.14.2. Childhood Behavior Checklist (Achenbach & Rescorla, 2001)

3.14.3. NIMHANS Index for Specific Learning Disabilities (Kapur, John, Rozario & Oommen, 1991)


3.14.5. Test of Visual Perceptual Skills (Gardner, 1996)


3.14.1. Kuppuswamy’s Socioeconomic Status Scale: Devised by Kuppuswamy in 1976. It is a composite score of education and occupation of the head of the family along with the monthly income of the family, which yields a score of 3-29. It consists of three variables of socio-economic status with seven component subdivisions in it (i.e. total 21 component sub-divisions). Each of these three variables are measured by means of a seven point weighted scale. This scale classifies the study populations into upper, upper middle, lower middle, upper lower and lower socioeconomic status. The test manual of the scale doesn’t give any evidence regarding reliability. However, when Sarmah and Hazarika (2012) studied the reliability of modified Kuppuswamy’s socioeconomic status scale for 2011 on 384 students of class- VIII, the reliability was found to be 0.83
(Spearman Brown coefficient) and 0.82 (Guttman split-half coefficient) using split-half method (Education and occupation of head of the family as one half, whereas monthly income of the family as second half); 0.74 using Cronbach alpha. The validity of a scale was found to be 0.91 using index of reliability (Sarmah & Hazarika, 2012). This scale has been tested for validity by various methods such as matching against outside criterion, distribution patterns, comparison of dichotomous groups as per the test manual. The forecasting efficiency of this scale was found to be 0.885 when all the three variables are used, while it is 0.733 when income is eliminated, 0.742 when education is eliminated and 0.667 when occupation is eliminated (Kuppuswamy, 1981). Education and occupation of head of the family are retained as it is not changeable with time. However, the income ranges in the scale are modified as per the value of the Indian rupee. In addition, this is one of the frequently used scales (Nag, 2011; Sreeja, 2014; Mahadeo, 2015) to assess socioeconomic status in India as mentioned in the article by Sharma and Saini (2014). The revised version of Kuppuswamy’s socioeconomic status scale for 2007 was used in the current study (APPENDIX-7a) (Kumar, Shekhar, Kumar & Kundu, 2007).

3.14.2. Childhood Behavior Checklist (CBCL): The CBCL was developed in 1991 and revised in 2001. It comprises of CBCL parent report form, youth self-report form and teacher’s report form. It can be completed in about 15-20 minutes and is applicable for children from 6-18 years of age. It comprises of questions to quickly assess the broad spectrum of competencies, adaptive functioning, and problems related to behavior, emotional and social skills. Likert-scale that ranges from zero - two (i.e. 0= not true, 1= somewhat or sometimes true and 2= very true or often true) is used to assess behavior, emotional and social problems. The measure is a 113-item inventory that comprises eight clinical syndrome scales (Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints,
Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior). The core scales are grouped into two broader scales, i.e. Internalizing and Externalizing scales, and a Total Problem Score. The Internalizing grouping consists of the sum of the scores of the Withdrawn, Somatic Complaints, and Anxious/Depressed scales. The Externalizing grouping consists of the sum of the scores of the Delinquent and Aggressive Behavior scales. The Social Problems, Thought Problems, and Attention Problems scales are included in the Total Problems Score, which includes all 8 core syndrome scales. Total score is used to determine percentile from which a profile for the child is formed as normal range, borderline or clinical range. Inter-rater reliability was found to be 0.96 and test-retest reliability was 0.95. Content validity, criterion validity, and construct validity were satisfied (Achenbach & Rescorla, 2001). In the current study, the teacher’s report form (APPENDIX- 7b) was used every year as a screening tool to include children who were in the normal range (i.e. <93rd Percentile) as per the selection criteria.

3.14.3. NIMHANS Index for Specific Learning Disabilities (SLD): Originally developed by John in 1989 for assessing children with LD, in 1991, Kapur et al., revised it and named it as NIMHANS index for SLD. The battery has norms for children in Standard I-V. It consists of two levels (Level-I consisting of tests for Attention, visual Discrimination, Visual Memory, Auditory Memory, Speech and Language, Visuo- motor skills and Writing Skills for 5-7 years and level-II consisting of tests for attention, language [reading, writing, comprehension], spelling, perceptual motor abilities, memory and arithmetic for 8-12 years). If an eight-year-old child is unable to perform adequately in Level-I tasks, it is suggestive of LD and if a 5-7-year-old child is unable to perform the same tasks adequately, it is suggestive of learning difficulty. In level-II, if a child’s performance is more than two standards below the current standard, it is suggestive of
LD and if a child’s performance is one standard below the current standard it is suggestive of learning difficulty. Reliability was found to be 0.53 and criterion validity was found to be satisfactory (Panicker, Bhattacharya, Hirisave & Nalini, 2015). This assessment tool was used every year in this study on an individual basis as a screening tool for learning disability (APPENDIX- 7c).

3.14.4. Raven’s Educational Colored Progressive Matrices (CPM): Raven’s educational CPM test was published in 1947 and was reviewed in 1956. It is made up of diagrammatic puzzles that are designed to assess the intellectual processes of young children. It is used satisfactorily with people from different cultural background and suitable for children from 4 to 11 years of age. It is a nonverbal measure of general ability and consists of 36 items in three sets of 12: A, Ab, and B. The test items are arranged in such a way that it assesses mental development up to the stage when a person is sufficiently able to reason by analogy and to adopt this way of thinking as a consistent method of inference. The test booklet consists of colored printed illustrations as a problem to be solved, and child needs to indicate the chosen figure to be inserted in the problem to be completed. Each right answer will carry one mark and wrong answer will not carry any marks. It takes a maximum of 15 minutes to administer the test, and the total number of the correct answers (i.e. total raw score) is taken into consideration for further interpretation. Normative data for Indian population has been developed in the year 2012, and the split-half reliability was found to be 0.88. It is considered to have adequate content validity, construct validity and criterion-related validity (Raven, 2004). It was used in the current study as a screening tool (APPENDIX- 7d) as it is extremely quick, cost-effective, applicable for cross-cultural contexts and suitable for educational settings. Raw score was converted into standard score and children who scored less than 90 in the standard score were excluded from the study, as according to this scale scores
less than 90 is considered as of low average and below intelligence. This test was administered in groups of 7-10 children in each group.

3.14.5. Test of Visual Perceptual Skills (Non-motor) - Revised (TVPS-R): TVPS-R was first published in 1982 and was revised in 1996. It is highly accepted and widely used by various professionals. It is a standardized and well-normed test and was developed for professionals to determine a subject’s visual perceptual strengths and weaknesses. The seven sub-tests are visual discrimination, visual memory, visual-spatial relationships, visual form constancy, visual sequential memory, visual figure-ground and visual closure with 16 items in each subtest. Items of each subtest are arranged progressively according to difficulty. TVPS-R is used from ages four through 12 years 11 months. Time required to complete the test ranges from 9-25 minutes. The test items consist of various forms and subjects are expected to perceive and interpret various forms. Each correct answer is scored one and wrong answer is scored zero. The minimum obtainable raw score is zero and maximum obtainable raw score is 112. The ceiling for scores in subtests is established when a subject fails (i) three out of four consecutive items on those subtests in which there are four choices, (ii) four out of five consecutive items on those subtests in which there are five choices. Scoring is computed by a number of correct responses that occur before the last incorrect response of the ceiling for each subtest. Reliability coefficients for the total score ranged from 0.83 to 0.91. The median reliability coefficients across all age levels ranged from 0.42 to 0.61, and the total group reliability coefficients ranged from 0.74 to 0.85. Reliabilities for individual subtests ranged from 0.27 to 0.80. This test is considered to have adequate content validity, construct validity, concurrent validity and diagnostic validity (Gardner, 1996). This test was used in the current study (APPENDIX- 7e) to measure visual perceptual skills as this test does not demand any language skills and is not biased according to race, culture, gender or education. According to the administration
guidelines, instructions can be given in any language while administering this test and is applicable for subjects of all cultures in all geographic regions worldwide. Standard procedure was followed as per the guidelines provided in the manual. The students were provided with test response sheet and asked to respond using a pencil in a well-lit and ventilated classroom. The students were also provided with tables and chairs while responding to the test items. The test was administered in groups of 7-10 children in each group. The derived sum of the scaled score from a raw score was considered for further statistical analysis.

3.14.6. The Beery-Buktenica Developmental Test of Visual Motor Integration (Beery VMI): The Beery VMI was first published in 1967, and the sixth edition was published in 2010. The sixth edition is strongly focused on early childhood education. It is one of the most valid and economical visual-motor screening batteries available for preschool to adult ages. The purpose of the test is to help in identifying significant difficulties in visual motor interaction and obtain needed services for individuals who exhibit these difficulties. It is hoped that through early screening, those children who may need extra help in their education or other aspects of development will be identified and referred to the appropriate professional for further evaluation and help. The 30-item Beery VMI for ages two through 100 can be administered to individuals or groups in about 10-15 minutes. This test includes a developmental sequence of geometric forms to be imitated or copied with paper and pencil. Correct and incorrect answers were decided based upon the guidelines mentioned in the test manual. Each correct answer is scored one and wrong answer is scored zero. Scores obtained after three consecutive errors were not considered for calculation and a sum of correct answers (i.e. total raw score) are considered for scoring. The minimum obtainable raw score is zero and maximum obtainable raw score is 30. Research indicates that it is virtually culture-free and is designed to evaluate the extent to which individuals can integrate their visual motor
abilities. Two optional standardized tests, the Beery VMI Visual Perception test, and the Beery VMI Motor Coordination test, are also available for those who wish to statistically compare an individual’s Beery VMI results with relative data of pure visual and motor performance. The overall test-retest reliability was found to be 0.88, and inter-rater reliability was 0.93. Content validity, concurrent validity, construct validity, and predictive validity is found to be adequate (Beery & Beery, 2010; Klein, 1978). According to the administration guidelines, instructions can be given in any language while administering this test. Standard procedure was followed as per the guidelines provided in the manual. The students were provided with test response sheet and asked to respond using pencil without using an eraser. The students were also provided with tables and chairs while responding to the test items. In the current study, the Berry VMI was administered (APPENDIX- 7f) in groups of 7-10 children in each group in a well-lit and ventilated classroom to test the visual motor abilities. The raw score was converted to a standard score, and the same was used for further statistical analysis.

3.14.7. Evaluation Tool for Children’s Handwriting (ETCH): The ETCH was developed in 1995 and reprinted in 2004. The criterion-referenced tool consists of ETCH- Manuscript (ETCH-M) and ETCH-Cursive (ETCH-C) designed to evaluate the manuscript and cursive handwriting skills of children in grades one through six. Its focus is to assess a student’s legibility and speed of handwriting tasks which is similar to the skills required to do the classroom activities. ETCH administration requires 15 to 25 minutes and scoring targets legibility of individual tasks, total tasks, and speed. It includes the following writing tasks: writing the lowercase and uppercase alphabets from memory (a–z), writing numerals from memory (1–20), near-point copying (5 words, 31 letters), far-point copying (7 words, 29 letters), writing from dictation (3 words, 1 zip code, 15 letters, 5 numerals), sentence composition (of at least 5 words) common for both ETCH-M and ETCH-C and manuscript-to-cursive transition (6 words, 31 letters) in
only for ETCH-C. Legibility scoring focuses on letter formation, size, alignment, case, and spacing. Letters, numerals, and words are judged for legibility using a list of specific criteria such as omission, closing, misplacing, reversion, and poor erasure. The percentage of legibility is determined for each task by counting the legible letters, numerals, or words and dividing by the total number of letters, numerals, or words required. The percentages from each task are then averaged to obtain a total legibility score for letters, numerals, and words. The minimum obtainable legibility percentage is zero and maximum obtainable legibility percentage is 100. The intra-rater reliability ranges from 0.55 to 0.80, inter-rater reliability ranges from 0.57 to 0.84 and test-retest reliability ranges from 0.24 to 0.61. The test is considered to have adequate discriminant and concurrent validity (Brossard-Racine, Mazer, Julien & Majnemer, 2012; Diekema, Deitz, & Amundson, 1998; Amundson, 1995). According to the administration guidelines, instructions can be given in any language while administering this test. Standard procedure was followed as per the guidelines provided in the manual. ETCH-M response sheet and students were asked to respond using pencil. The students were also provided with tables and chairs while responding to the test items. The classrooms were well-lit and ventilated. This scale was administered (APPENDIX- 7g) in groups and total legibility scores (i.e. average of total word legibility percentage, total letter legibility percentage and total numeral legibility percentage) were taken into consideration for further analysis.

3.14.8. **Academic Performance Index:** The semester scheme of examination was followed in both government aided and private schools where exams were conducted twice in a year. The academic performance index was obtained from school marks record in each subject for two consecutive examinations [September & March] in the respective academic year. All the schools followed Karnataka state board curriculum except for two schools which followed central board of secondary education curriculum. Additionally,
the class teacher was also asked to score their perception of the academic performance of each child in 0-100 point rating scale. The marks obtained from the school record was converted to 100 and was used for further statistical analysis.

3.15. Procedure

The study was initiated in the year 2013 and was completed in the year 2017. The procedure of the study is illustrated in Figure 3.1.

The investigator approached the Village Accountant to get the list of schools in Shivalli village. The approval from the Department of Education, Udupi district was obtained to conduct the study in government schools. The school authorities were approached and explained about the study objectives. General information about the schools such as, the type of school, number of children, expected drop outs, the medium of teaching, and examination pattern was obtained followed by the permission to conduct the study. Ethical approval was obtained from the IEC, Kasturba Hospital, Manipal.

The list of children studying in the second standard during the time of recruitment was collected from schools to identify the cohort for the follow-up. Out of 267 children, 210 children who were in the age-group of seven-years were selected. The remaining were excluded as they did not meet the selection criteria for age. The subject information sheets were provided to the parents in their primary language (English/ Kannada). The parents of the selected children were explained about the study in person or through the telephone. Written informed consent was obtained from parents for allowing their children to participate in the study and verbal assent was obtained from children for their willingness to participate in the study.
Initial screening was started in November 2013 and was completed in January 2014, when children were in the second standard. The investigator fixed an appointment with schools for screening the children, which was done on an individual and group basis. The screening was carried out as follows: The children responding to their name call were considered as having no hearing problem. The optometrist screened children for any visual defects specifically for refractive errors and squint. The investigator underwent training for 10 days under two senior faculties from the department of Clinical Psychology on CBCL, NIMHANS index for SLD and Raven’s Educational CPM. The investigator administered the screening tools only when the supervisors were satisfied by the investigator’s performance in administering the test. The CBCL (to rule out clinical syndromes such as Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social problems, Thought problems, Attention Deficit/Hyperactivity problems, Rule-Breaking Behavior, and Aggressive Behavior), NIMHANS index for SLD (to rule out LD) and Ravens’ Educational CPM (to rule out IQ less than 90 in the standard score) were administered by the investigator under the guidance of a Psychologist initially and subsequently by the investigator independently.

Out of 210 children, none of the children were identified as having any visual defects or clinical syndromes (as mentioned earlier). Two children were identified as having intelligence less than 90 in the standard score which was discussed with concerned school authority and parents were informed about the same for further consultation. 16 children were identified as having ‘learning difficulty’, but were not excluded from the study as according to NIMHANS index for SLD tool, children with learning difficulty are ‘at risk’ for LD and with appropriate exposure can acquire skills. 10 out of 16 children showed errors across all components in Level-I and the remaining 6 children showed errors majorly in visual discrimination, visual memory and writing skills. The plan was to administer NIMHANS index for SLD tool for the next two years to rule out LD.
Chapter 3

Method

Data were analyzed and results were interpreted

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*Figure 3.1*: Procedure Flow Chart
The investigator initiated the administration of primary measures to measure the VP, VMI, and handwriting in the month of February 2014 on the selected 208 children (54 from government aided schools and Kannada medium; 154 from private schools and English medium) and completed it by April 2014. The assessments were done with prior appointments from the schools so that it would not interfere with the school activities. At the end of the academic year, the marks of two consecutive exams and also teachers’ perception of the academic performance of each child were collected. The collected data were entered, analyzed and interpreted.

The schools were approached to fix appointments to re-administer the second round of tests on the same children when the students were promoted to the third standard. The screening for visual defects by an Optometrist and LD, clinical syndromes (as mentioned earlier) by the investigator was carried out from November 2014 to January 2015. Ten children were identified as having ‘learning difficulty’, but were not excluded from the study as according to NIMHANS index for SLD tool, children with learning difficulty are ‘at risk’ for LD and with appropriate exposure can acquire skills. All 10 children were able to perform adequately in Level-I but 6 children showed errors majorly in language skills and 4 children showed errors majorly in arithmetic in Level-II. Six children who were identified as having LD (4 children: major errors in visual memory, visual discrimination, speech and language in Level-I and major errors in language, spelling and memory in Level-II, 2 children: errors in all the components of Level-I and Level-II) were excluded from the study and referred for further consultation. The number of children came down to 198 from 208 due to LD (6 children), migration (3 children) and long absenteeism (1 child).

The second round of administration of the test to measure VP, VMI, and handwriting were initiated during February 2015 and completed by April 2015 to the
remaining 198 children (48 from government aided schools and Kannada medium; 150 from private schools and English medium). The assessments were done with prior appointments from the schools so that it would not interfere with the school activities. At the end of the academic year, the marks of two consecutive exams and also teachers’ perception of the academic performance of each child were collected. The collected data were entered, analyzed and interpreted.

In November 2015, the schools were approached again to fix appointments to re-administer third round of tests to the same children when they were in the fourth standard. The screening for visual defects by an Optometrist and LD, clinical syndromes (as mentioned earlier) by the investigator was carried out in the third round from November 2015 to January 2016. Five children who were identified as having LD (5 children: performed adequately in Level-I, 3 children: errors in all the components and 2 children: major errors in language, spelling and arithmetic in Level-II) were excluded from the study and referred for further consultation. The number of children came down to 191 from 198 due to LD (5 children) and migration (2 children).

The administration of tests to measure VP, VMI, and handwriting were initiated during February 2016 and completed by April 2016 to those 191 children (48 from government aided schools and Kannada medium; 143 from private schools and English medium). The assessments were done with prior appointments from the schools so that it would not interfere with the school activities. At the end of the academic year, the marks of two consecutive exams and also teachers’ perception of the academic performance of each child were collected. The collected data were entered, analyzed and interpreted.
3.16. Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 15 was used to analyze the data. Descriptive statistics namely frequencies, mean and standard deviation (SD) were obtained and reported for categorical and continuous variables respectively. Pearson product moment correlation was obtained between academic performance based on school mark record and teacher’s rating scale. This was done to assess the strength of linear relationship between these two academic performance scores and if there exists a good correlation, any one of the two academic performances could be used for further analysis.

Independent sample t-test was used in the current study to assess the difference between mean academic performance among demographic variables such as gender, type of school, family type, peer interaction, participation in extracurricular activities and exposure to preschool in a second standard, third standard and fourth standard. One-way Analysis of Variance (ANOVA) was used to compare the means of academic performance within the categories of socioeconomic status, VP, VMI, and handwriting in second, third and fourth standard children followed by Tukey’s and Games-Howell’s Posthoc test based on the assumption of homogeneity of variances. Multiple Linear Regression using enter method was used to identify the predictors factors of academic performance. For multiple linear regression analysis, the variables VP, VMI, and handwriting were considered as continuous for better interpretation. The change in the VP, VMI, and handwriting over a period of three years was analyzed using Repeated Measures of ANOVA. For all the above analysis, p<0.05 were considered as statistically significant.