



Differences in Learning Style Preference of Key Stage 1 and Key Stage 2 Pupils in Primary School, using the VARK Model.

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Contents

ABSTRACT

This study investigates learning style preferences among children in Key Stage 1 and Key Stage 2 primary school. It looks for differences within Key Stages, and additionally notes variances in whole-school and gender preference. The sample consisted of 56 pupils, 26 KS1 and 30 KS2, who attended mainstream primary school based in Manchester. Pupils took part in four 'challenges', testing each of the VARK learning styles (Fleming and Mills, 1992); Visual, Auditory, Read-Write and Kinesthetic. A teacher/ teaching assistant then completed an adapted VARK questionnaire based on own perception of individual pupils learning style. Both test scores and questionnaire data was recorded and analysed using SPSS via Mixed ANOVA, t-test and Pearson's correlation coefficient.

The data established significant interaction between Key Stage and learning preference, *Wilks' Lambda* = .829, *F*. (3, 52) = 3.573, *p* = .020, *partial eta squared* = .171. The study also found no significant difference between gender and no significant whole-school preference, although when compared via t-test, kinesthetic learning preference appeared dominant. These findings were consistent with previous literature. The present study provided new literature on differences within primary children, which can be used by educators to improve attainment and motivation of pupils. Ideas for future research have been suggested in order to provide depth and knowledge into Key Stage and learning preference, such as investigating multi-modal preferences and Key Stage.

KEY WORDS:	LEARNING STYLE	KEY STAGE	ATTAINMENT	KINESTHETIC	PUPILS
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Introduction

Learning Styles

This study aims to find differences in learning preferences through ability to retain information between Key Stage 1 and Key Stage 2 pupils in primary school, using the VARK inventory. To do this one must begin evaluating previous literature surrounding learning styles and more specifically VARK (Fleming and Mills, 1992).

'Learning style' is defined as how individuals concentrate and their method in processing and acquiring information and experience (Jantan and Razali, 2002). It refers to favored strategy used whilst learning and includes distinctive tendency to differentiate and process information (Othman and Amiruddin, 2012). Learning styles consider personal factors such as age, personality and gender, together with environmental influences, parents' education, school, community and culture. Over the last 40 years, evidence from psychological literature has supported the suggestion that students of all ages, including primary school children, have varied yet consistent ways of responding in learning situations, or in other words, have preference in processing and assimilating information (Fleming and Mills, 1992). However, what literature cannot appear to agree upon is whether learning style preference has a relationship with age, gender or attainment (Khanal et al. 2014). This research will aim to focus upon age differences, as well as giving comment on gender differences, between learning preferences in two separate groups within primary school.

VARK Inventory

There are numerous learning style inventories which focus on preference, however this study utilises the VARK inventory (Fleming and Mills, 1992). This inventory subsists in the category of 'instructional preferences', which is concerned with learners 'comfort and fit' with specific instructional methods such as lecture, discussion or independent work (Claxton and Murrell, 1987). VARK was initially developed from the VAK inventory (Stirling, 1987), this focused on visual, auditory and kinesthetic modalities, but was deemed inadequate to account for differentiations noted among learning, and therefore the 'visual' modality was divided into two subsections; diagrammatical (graphs, charts, diagrams) and printed words (Fleming and Mills, 1992) this formed the forth modality: 'read-write'.

Pupils with preference for visual learning tend to use symbolic strategies such as models and graphs, which represent printed information. Those which gravitate towards auditory, prefer 'heard' information, such as lectures and discussion. Read-write individuals prefer printed text, which are included in textbooks and notes. Whereas kinesthetic learners employ a combination of sensory functions to feel learning experiences, through simulations of real practices such as field trips (Shah et al, 2013). Data from 45,826 respondents representing the general population and their uni-modal learning preference is shown below.

VARK Questionnaire Data (Fleming, 2017).

Visual 20.5%
Auditory 24.5%

Read-Write 27.4%
Kinesthetic 27.8%

However, little research has been conducted on preferences in primary school, so one cannot assume general population will be reflective of children, especially as the VARK website is based upon adult responses to questionnaires and therefore, generalizability to children ages 6-10 years is insufficient.

VARK focuses on diverse ways one takes in and gives out information (Hawk and Shah, 2007), it is designed to act as an instrument of self-knowledge and exploration of opportunities for making education enjoyable and productive for both teacher and pupil (Murphy et al, 2004). The differentiation between VARK and other inventories, is VARKs primary purpose is to advise, it suggests preference of learning but does not diagnose or predict style to be concrete. Instead it allows fluidity and aids learning improvement by applying information VARK provides (Miller, 2001). Research of VARK styles and preference are said to differ within age. Miller (2001) concludes 29% of primary school pupils learn best through visual modes, this could be due to the fact pictures and visual aids are regularly used in primary, in comparison to university students who tend to have higher preference towards read-write modality at 41% (Murphy et al, 2004), possibly due to adaption to mainly lecture-style based learning. This suggests individual's preferences may modify to teaching styles, which is important to note as it implies the way one differentiates teaching may produce a variance in learning preferences within this study. Shah et al (2013) noted kinesthetic was most preferred among both males (45.8%) and females (50%). The assorted results documented in literature makes it difficult to grasp full understanding or conclusion of preferences in primary school, making it problematic for educators to adapt teaching styles to suit learners and gain maximum attainment. This gives scope for new research, focused specifically within primary school, adding to literature and providing meaningful conclusion.

VARK inventory was implemented due to strong face validity, simplicity, ease of use and wealth of learning materials designed to accompany it (AlKhasawneh, 2013), moreover VARK received high acclaim from pupils and teachers for straightforwardness and ability to create discussions about learning (Miller, 2001). Nonetheless, like many inventories it did not come without critics, several remain unconvinced of benefits of style-based teaching, despite the large body of research suggesting otherwise. They believe active participation and interest of teachers, irrespective of approach, effect pupil's motivation and learning, greater than learning preference (Miller, 2001). Not all educators agree matching teaching style to learning preferences improves education, some researchers suggest strongest preferences are not always most suitable (Murphy et al, 2004). The most-likeable modality may not be the best way to learn, it depends on situation and factors such as age, schooling and subjects (Spoon and Schell, 2001). Therefore, individuals would need to adopt multiple modalities and become more diversified within education to improve attainment.

Uni-Modal and Multi-Modal Preferences

Some pupils have strong preference for any one, single modality (uni-modal), however the majority of individuals appear to be multi-modal, they actively select different

modalities to favor for different tasks. Most will learn effectively as long as teaching methods adopt a blend of activities that stimulate visual, auditory, read-write and kinesthetic modalities (Laxman et al. 2014). As many as 86.8% of pupils were multimodal (Prithishkumar and Michael, 2014), nevertheless, this is presented positively, as over-resilience on one style and unwillingness to adopt another, hinders learning due to incomparable teaching styles. Shah et al (2013) found 36% of learners used all modes of learning (quadmodal), 18% were bi-modal or tri-modal, and 45.8% uni-modal, strongest preference being kinesthetic. This demonstrates importance of teachers adopting multiple modes of information presentation, which appears necessary to keep motivation of pupils and requires shift from traditional, teacher-centered, lecture style to student-centered, interactive, multi-modal approach (Prithishkumar and Michael, 2014). Although since learning style research has published, schools appear to have begun adopting diverse methods of teaching, such as interactive sessions, yet whether this development is occurring within higher education is questionable.

Justification for Study of Learning Styles

Knowledge of learning preferences may help teachers identify and solve issues in learning among students and consequently, help pupils become effective learners (Shah et al, 2013). Research shows performance and motivation improve when instruction is adapted to learning styles (Miller, 2001), suggesting when teachers style is compatible with pupil's style, pupils will be more encouraged, therefore academic performance will increase. Questioning that if pupils have considerably different learning styles, is it not unprofessional and irresponsible to teach each pupil the same lesson in the same fashion, without pinpointing distinctive assets and providing responsive teaching (Miller, 2001).

Educators have responsibility to understand differences within primary schools and present information in an array of ways, in order to accommodate each learners' preferences (Miller, 2001), if active participation of pupils and suitable instruction is given, learning will improve. Wilson (1998) supports this by stating achievement and motivation advance when learning and teaching styles match. The brain is thought to reject information it finds no connection to, or which meaning is incomprehensible (Parnell, 1996), suggesting learning without association to learning style, is meaningless for effective education. This necessitates educators to efficiently deliver according to requirements of pupil (Prithishkumar and Michael, 2014), which is why it is vital for teachers to know what modality pupils favor. Becker et al. (2007) believe although conventional learning methods are fundamental and should be practiced (lecture-style, textbook, discussion), teachers should differentiate teaching style in order to satisfy pupils distinctive learning preferences, they should attempt to combine different pedagogy approaches in each component of instruction to meet distinctive styles.

However, it is not realistic to expect educators to deliver lessons that accommodate learning preferences of all. The array of style dimensions and consequently the combinations that occur within class are likely to be so extensive that educators are incapable of extending range of teaching to include all (Mills, 1989). Realistically pupils should be encouraged to adapt learning and be flexible towards lessons, gaining information or knowledge supported by own learning style (Fleming and Mills, 1992).

Attention to preferred learning styles by pupils allows flexibility to adapt behavior based on whether lessons are presented in favored learning style or not. Many aspects of preferences are difficult to change, such as time of day, food intake and motivation (Fleming and Baume, 2006), therefore being able to modify learning can be advantageous towards attainment. In spite of that, how realistic is it to expect children ages 6-10 years to have ability to gain knowledge of and apply learning preference to education.

Justification for New Research

It is envisaged that research will uncover and highlight differences between Key Stage 1 and Key Stage 2 learning style preferences through the ability to retain information. It will be interesting to discover what specific preferences each Key Stage holds and whether this is an effect of age, as well as noting any potential differences gender may have upon preference.

Research Aims

To investigate differences in learning preferences through ability to retain given information between Key Stage 1 and Key Stage 2 pupils in primary school, using the VARK inventory.

Research Questions

1. Is there significant difference between the number of primary school children who prefer each learning style in VARK?
2. Is gender a contributing factor for learning style preference within primary school?
3. Is age (Key Stage) a contributing factor for learning style preference within primary school?

Research Hypothesis

There will be a significant difference between amount of words recalled in each learning style preference and Key Stage. However, given limited and inconclusive amount of research conducted specifically on learning styles and memory within different age groups in primary school, the direction of this prediction cannot be assumed.

Methodology

Design

This study aims to find differences in learning preferences through retention of information between KS1 and KS2 pupils, using the VARK inventory. KS1 is the legal term for year 1 and 2 schooling in England and Wales, KS2 incorporates years 3, 4, 5 and 6. VARK, initially introduced in 1992 by Fleming and Mills identifies four modal preferences; Visual, Auditory, Read-Write and Kinesthetic. To find differences in learning style preference within primary school, a within-participant experimental design will be utilised. There will be one between-factor being Key Stage (independent

variable), and one within-factor with four levels, being each learning styles test (dependent variables). Each participant, 26 from Year 2 and 30 from Year 5, will complete four conditions within usual classroom, representing four styles in VARK. The first condition will test visual learning, asking participants to learn 10 words over a five-minute period by viewing images on a power-point for 30-seconds each. The second condition will test auditory learning, asking participants to listen to the researcher read 10 words, each repeated twice with a three-second pause between and taking two-minutes to complete. The third condition will test read-write modality, asking participants to read, copy and write out 10 words, they will have 30-seconds to write each word (five-minutes overall) and the last condition will test kinesthetic learning, asking participants to create playdoh structures of 10 words, spending one-minute on each (10-minutes overall). After each condition participants will attempt to recall words learned after an hours break and five-minute settling period. The four different word lists are formed of a mix of KS1 and KS2 high frequency words found in all primary schools (Appendix.6). These tests will enable identification of each participant's preferred learning style by the modality they score the highest amount of recalled words in, representing greatest volume of learning.

Participants

The school partaking in this study is one the researcher has previously worked within, allowing rapport and trust to be build with participants, as well as teachers/ parents who are allowing their child to participate. Participants will be recruited by specific year group, Year 2 selected to represent KS1 (6-7 years old), due to greater understanding of study as opposed Year 1 children. Preferably, this study would use the oldest Key Stage 2 group, Year 6. However, this was not selected due to increased workload for final year of junior school. Instead, Year 5 was selected to represent KS2 (9-10 years old), being the alternative oldest group and demonstrating the widest age gap for participating groups as possible.

This study had 56 participants, 26 in Year 2 (12 males and 14 females) and 30 in Year 5 (13 males and 17 females) this represents a moderately sized sample group for each Key Stage in primary school. Allowing data to be comparable between age group and representable to other schools.

Measures

Experiment

After gaining signed consent from headteacher (gatekeeper), as well as an adapted signed consent from each participant, the study began. The class was given instructions for each individual learning condition and told they were completing a 'challenge' to ensure minimal distress, they were asked if they had any questions before the study and confirmed they all understood procedure.

Visual

Firstly, visual learning was tested, instructions were shown and read out from a power-point slide, instructions must be kept simple to ensure children understand, for example, 'CHALLENGE 1: REMEMBER THE PICTURE AND WORD'. The test began

at 12:10pm (Year 2) and 12:20pm (Year 5) and finished after five-minutes. Children were shown individual slides containing on each, one of 10 images and the written word in large, bright, visually engaging font, each slide was shown for 30-seconds before moving onto the next word (Appendix.7.1). Teacher and Teacher Assistant are used to ensure children within the class remained silent and did not make note of any of the words. The children then took usual lunch break for one hour, before returning to class, having five-minutes to settle and then being asked to write down the words they have previously seen on blank-lined paper without discussion, they had five-minutes to do this and then the sheet was collected for marking. It is important that the children were sat each with a space between the next child, to ensure no copying of words as this could effect the reliability of results.

Auditory

Secondly, auditory learning was tested. Participants were given instructions, 'CHALLENGE 2: LISTEN TO THE WORD'. The researcher then read out 10 different words, repeating each word twice with a three-second pause between, to ensure participants hear correctly. This test took two-minutes as opposed to five. After completion children were then sent on their usual lunch break and after one hour and a five-minute settling period, were asked to recall in same way as previously described.

Read-Write

Thirdly, read-write condition was tested by issuing a handout. This handout contained written instructions such as 'CHALLENGE 3: READ WORD AND COPY ONTO DOTTED LINE'. The handout had 10 written words on with a blank line underneath each for them to copy the word onto, as they would usually do in handwriting practice (Appendix.7.2). They had 30-seconds on each word and was told when to move onto the following word, the study took five-minutes overall. Once completed children took usual hour lunch break and five-minute settling period before being asked to recall in same way as previously stated.

Kinesthetic

The last condition tested was kinesthetic learning, participants were given instructions such as 'CHALLENGE 4: MAKE PLAY-DOH SCULPTURE OF EACH WORD'. Each of the 10 words were then read out one at a time by the researcher and children had one-minute to complete each sculpture (30-seconds was not sufficient time to complete challenge). After completion, children had an hour lunch break and five-minute settling period before being asked to recall in same way as previously stated, recall began five-minutes later than in other conditions to allow same amount of time between part one and two of study.

Questionnaire

After the four conditions concluded, all participants and consenting adults were debriefed and informed of support details such as Manchester Metropolitan University counselling services and complaint procedures (Appendix.8). The teacher/teaching assistant was then given explanation of how to complete the questionnaire

(Appendix.5) and told they had one week from end of study to complete each participant's questionnaire and return to researcher.

The questionnaire (Appendix.5), was used to check validity of test results. Questions included statements for the participant to select, such as 'Prefers exercises where you have to match objects by shape and colour' (Visual) and 'Contributes ideas in lists or in writing' (Read-Write). The main teacher for Year 2 and a teaching assistant for Year 5 (someone who works closely to participant, daily), completed this questionnaire on participant's behalf, this expresses the level of consistency between teacher's observation of participants preferred learning and actual participant preference. Which strengthens validity and reliability of study by providing a secondary view of participants preferred learning style.

The questionnaire issued within this study is Fleming's (2012) 'VARK for Littles'. This is an adapted version of the original VARK questionnaire, which is appropriate for 5-12 year olds. This questionnaire is based on identical principles of modal preferences and children's choice, but is completed by observations made by teacher/teaching assistant to build a VARK profile that will help others understand the child's preference for learning. As this questionnaire is already in public domain, permission for use was not required.

Ethical Considerations

Before beginning this research, ethical approval was granted from Psychology Ethics Committee at Manchester Metropolitan University, in line with the British Psychological Society guidelines. The head teacher of school, where the study will take place, received an Invitation Letter (Appendix.1) and attached Study Information sheet, giving detailed explanation of the study's aims, objectives and methodology (Appendix.2). An Informed Consent sheet (Appendix.3), was signed, dated and returned to researcher before study began. Participants received an adapted informed consent sheet that was understandable for children, they were asked to write their name in the space provided to agree to take part within the study (Appendix.4). If the participant wished to not participate they were not forced to, however this was not an issue within this study. The study manipulated 'normal' lesson activities, incorporating the whole class, to reduce risk of distress.

Procedure

Quantitative data was accumulated and analysed by test results, learning of a list of 10 different high-frequency words, suitable for Key Stage, was completed in each learning style. Participants spent five-minutes learning the visual and read-write conditions, two-minutes learning the auditory condition and 10-minutes learning the kinesthetic condition. Conditions were kept as close to five-minutes as possible, however the nature of each tests warranted differences in duration. Participants were asked to write words on a blank-lined sheet of paper without discussion after an hour break and five-minute settling period. Children were sat each with a gap between the next to ensure no copying of results. After a five-minute duration all results were collected, then marked and noted down in a results table, displaying four different condition results and the participant's name, this table will not be published with the real-names of children for anonymity purposes, however a copy of real-names will be

kept by the researcher until submission in case participants wish to withdraw data. The additional questionnaire, which was completed by participants teaching assistant or teacher, was finalized and returned within one week of study.

This study encompasses four learning conditions and 40 high-frequency words, suited to specific Key Stage (Appendix.6), each condition tested one of the four relevant learning styles in the VARK inventory and tested 10 different words in each condition. One class of 26 children from Year 2 completed all four conditions over the course of two weeks, each test with a three/four-day gap between to allow for normal class learning to commence without interruption. Each test was carried out at the same time of day (12:10pm) to account for any effect time-of-day or tiredness may have on results and the classes lunch time break followed shortly after completion of the first part of the test. The second part of the test, where children attempt to recall learnt words commenced at 1:20pm (1:25pm for the kinesthetic condition), directly after lunch break. This is to ensure words are learnt rather than just briefly remembered.

One class of 30 children from Year 5 also followed this same procedure on the same days as the Year 2 class, however as lunch breaks are later for juniors than infants (Year 2) the tests began at 12:20pm each day and the second part of the test commenced at 1:30pm, except for in the kinesthetic condition where it initiated at 1:35pm. Once data was gathered it was stored in a password protected computer and hard copies were kept in a locked draw, data was then input and analysed by SPSS (statistical analysis programme) and after submission copies of data were deleted.

Results

Research Question 1

Is there significant difference between the number of primary school children who prefer each learning style in VARK?

Data output highlights that 6 of 56 cases are missing, this is due to participants scoring the same score on two or more levels, suggesting these learners are multi-modal. It must be taken into consideration that missed cases could produce bias or fault in results, however this is something that could not be controlled within the experiment.

The number of participants who scored highest in each preference within both Key Stage's as a whole and separate Key Stages is documented below in Table 1.

Table 1: Whole-School Preference for Four Areas of Learning Style Preference.

	Preference				
	Visual	Auditory	Read-Write	Kinesthetic	Total
Year					
2 (KS1)	7	2	4	11	24
5 (KS2)	5	5	8	8	26
Total	12	7	12	19	50

This cross tabulation demonstrates that in terms of test scores, this school as a whole has least preference for Auditory (T=7), and the highest preference for Kinesthetic (T=19). This slight difference in test scores is also shown by separation of the two Key Stages. Although Year 5 has multiple lowest and highest preferences, both age groups mirrors the total score with Auditory being lowest (KS1=2, which is lower than expected count of 3.4 and KS2=5, which is higher than expected count of 3.6) and Kinesthetic being the highest (KS1= 11, with lower expected count of 9.1 and KS2= 8, with higher expected count of 9.9). However, statistically analysing data through a Pearson Chi-square test of independence, to examine association between the learning styles in primary school students, the association between variables was not significant $\chi^2 (1, N = 50) = 3.351, p=.341$. This suggests there is no significant difference in preference within primary school, nevertheless from looking at the table one can infer there appears to be slight difference between learning style preference within each year group, as in Year 2 nearly half (11/24) pupils prefer Kinesthetic learning. If conducted with a larger sample significant differences may be found.

Research Question 2

Is gender a contributing factor for learning style preference within primary school?

The number of both male and female participants who scored highest in each preference within both KS1 and KS2 is documented below in Table 2.

Table 2: Gender Preference for Four Areas of Learning Style Preference.

	Preference				
	Visual	Auditory	Read-Write	Kinesthetic	Total
Gender					
Male	5	4	6	7	22
Female	7	3	6	12	28
Total	12	7	12	19	50

This cross tabulation appears to show both genders have highest preference for Kinesthetic (M=7, lower than expected count of 8.4 and F=12, higher than expected count of 10.6), and both genders also have same lowest preference being Auditory (M=4, higher than expected count of 3.1 and F=3, lower than expected count of 3.9). Yet, when Pearson Chi-square test of independence was applied to examine association between gender and learning style preference in primary school students, the association was not significant $\chi^2 (1, N = 50) = 1.088, p=.780$. This suggests there is no significant difference between gender and learning preference within primary school.

Research Question 3

Is age (Key Stage) a contributing factor for learning style preference within primary school?

This addresses the overall mean score for each learning style, it includes a total of all 56 participants as opposed to 50 participants (missed cases) in the preference tables displayed previously (Table 1. and Table 2.).

Table 3. Means and Standard Deviation of Four Areas of Learning Style Preference for Both Key Stages.

Learning Styles	Key Stage (KS)					
	KS1 (N=26)		KS2 (N=30)		Total (N=56)	
	M	SD	M	SD	M	SD
Visual	5.65	2.38	5.60	2.14	5.63	2.24
Auditory	4.42	1.90	6.40	1.96	5.48	2.16
Read-Write	4.54	1.82	6.03	1.96	5.34	2.02
Kinesthetic	6.58	2.21	6.67	2.02	6.63	2.09

The descriptive statistics in table 3 shows Year 5 (KS2) performed better on all areas of learning preference except visual, compared to Year 2 (KS1). The mean averages are higher on each preference for KS2 which suggests that between KS1 and KS2 learning strengthens in all styles, however visual stays similar. The total score offers an insight into whole-school preference, it shows that highest average result scored is for Kinesthetic (Total=6.63). The lowest average preference throughout was Read-Write (Total=5.34). The difference between Key Stage is shown by mean scores, the largest difference (1.98) between Auditory (KS1=4.42, KS2=6.40) and least difference (0.5) between Visual (KS1=5.65, KS2=5.60).

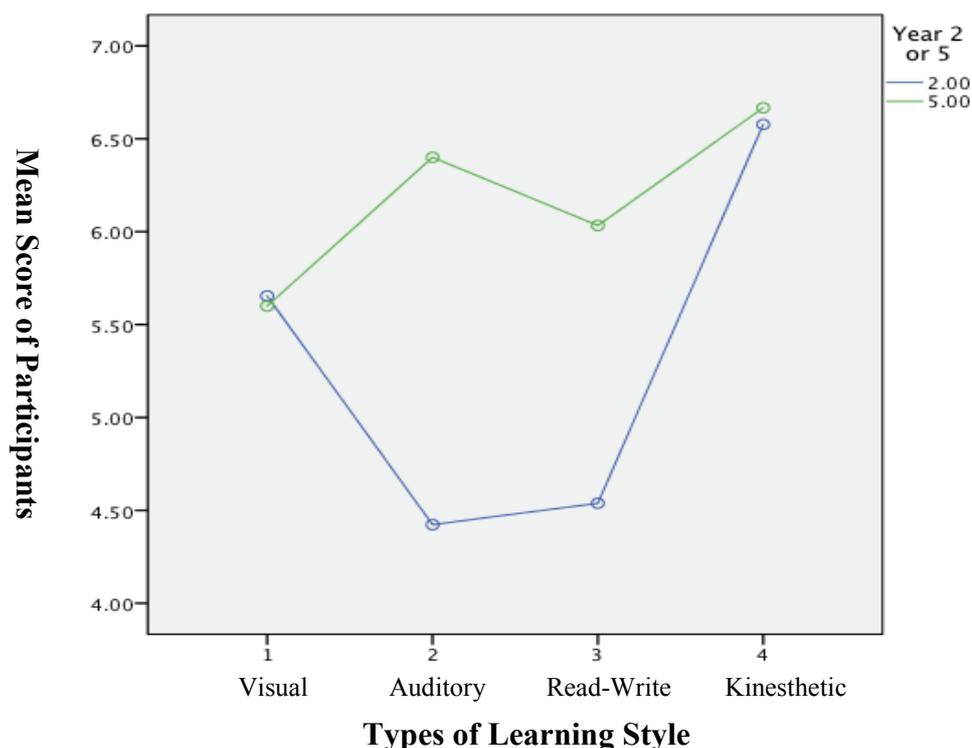
As this study has one between factor, comparison between Key Stage 1 and Key Stage 2 results. And one within factor, being learning preferences with comparisons between four levels (V.A.R.K), data was analysed by mixed ANOVA. A significant interaction was found between learning preference and Key Stage, *Wilks' Lambda* = .829, *F*(3, 52) = 3.573, *p* = .020, *partial eta squared* = .171. This suggests learning style preference depends on age group.

There is a significant main effect between each of the 4 learning style preferences, *Wilks' Lambda* = .789, *F*(3, 52) = 4.648, *p* = 0.006, *partial eta squared* = .211. However, further t-tests were needed to identify direction of difference, or in other words to discover which learning style has higher preference. Six paired sample t-tests were conducted (V-A, V-R, V-K, A-R, A-K, R-K). Results showed that all learning style interactions with Kinesthetic were significant, (V-K = .027, A-K = .009, R-K = .001). All other interactions had no significant difference, meaning kinesthetic is significantly the

strongest preference in each Key Stage and Visual, Auditory and Read-Write are all similarly preferred.

There is a significant difference between age group $F(1, 54) = 13.405, p = .001$. From Graph 1 one can tell that Year 5 is significantly better at all learning style tests, except visual, than Year 2.

Graph 1: Graph Comparing Year 2 and Year 5 Learning Style Preference Scores.



Questionnaire data was analysed by correlation between teacher/ teaching assistant’s assumed preference and participant test preference. The relationship between participants visual learning style preference and teachers perceived learning style preference was investigated using Pearson’s correlation coefficient, there was a medium positive correlation between variables, $r = .462, n = 56, p < .005$, The Auditory relationship also had medium, positive association, $r = .440, n = 56, p = .001$. Read-Write relationship had strong, positive correlation, $r = .563, n = 56, p < .005$. Kinesthetic relationship also had strong, positive association, $r = .641, n = 56, p < .005$. Each correlation shows positive association between teacher’s perception of participants learning style and participant test learning preference, which increases validity and reliability of study.

Discussion

Summary of Results

This research set out to investigate differences in learning style preferences through the ability to retain information between KS1 and KS2 pupils in primary school with

use of the VARK inventory (Fleming and Mills, 1992). The study discovered a significant interaction between age group and learning style preference. Findings also revealed no significant differences between gender and learning style preference and no significant difference between whole-school learning preference.

Findings and Implications

Whole-School Learning Style Preferences

After analysis of data collected, results demonstrated no significant difference between variables when both age groups were analysed together, showing a slight but not significant preference for learning styles within school. These findings imply that in primary schools as a whole there is no statistically significantly dominant learning style, however as there is a slight difference in preference scores, if conducted with a larger sample of participants from all ages in primary school the result may in fact become significant and offer a favored style amongst primary aged children.

In terms of Miller's (2001) research, a high preference for Visual modality should be apparent within primary school, however this was not the case. A slight but not significant preference was suggested for kinesthetic learning. It is important to note that development or change in teaching methods since Miller's (2001) work, could have a causal relationship with children's preferred learning style as pupils are often encouraged to adapt and make alterations to their own learning preference, in order to fit teaching style of educator (Fleming and Mills, 1992), suggesting if children are taught in a predominantly multi-modal classroom, their learning style may also be multi-modal, similarly, if children are taught in a largely kinesthetic classroom they may favor this style.

Gender Differences in Learning Style Preference

This research showed no significant differences between gender for learning style preference, this result supports research by Shah et al. (2013) who states no gender differences in learning style preference through VARK or any other inventory. Shah et al. (2013) also note Kinesthetic learning was most preferred among both boys and girls, which was further reinforced by this research which concluded the highest amount of participants scoring greatest on kinesthetic learning test (19/50) for both male (7/22) and female (12/28). However, this is a smaller percentage for kinesthetic as found by Shah et al (2013), which warrants further investigation, possibly with a larger sample size and even boy-girl ratio.

Differences in Key Stage and Learning Style Preference

When year groups were analysed as separate Key Stages a significant interaction between learning style preference and age group was found. This supports hypothesis which states a significant difference between Key Stage and preference will be apparent. The largest difference in age group was found between Auditory and Read-Write learning and least difference in age group was found between Visual and Kinesthetic learning. This suggests development in Auditory learning styles from Year 2 to Year 5, as it was found that Year 5 were consistently better at all learning style tests, except visual, than Year 2. In line with Miller (2001), who concludes 29% of

primary pupil's favor visual. This could, as previously mentioned, be due to teaching styles and how they differ between KS1 and KS2 educators. Likewise, Murphy et al. (2004) found that as individuals reach the end of education they shift to predominantly lecture-based learning, therefore they have highest preference for Read-Write and Auditory learning, which may explain the large improvement due to a shift to more mature leaning/ teaching styles between KS1 and KS2 in these modalities. With this in mind, it seems logical for teachers to adapt teaching styles to suit Key Stage, for example teaching KS1 with visual and kinesthetic techniques such as pictorial presentations, then shifting to more auditory and read-write based teaching as a child progresses through education, using methods such as story telling and word comprehension exercises. As literature suggests when teaching and learning styles match motivation and attainment in pupils improve (Miller, 2001), thus as an educator being aware of differences in preference between age groups, as shown in this study, is crucial.

Kinesthetic Learning Style

An overarching theme to this study demonstrates the strong preference of kinesthetic learning above the other three preferences. This is shown in associations displayed in the mixed ANOVA results, which demonstrates the only significant difference between preferences was found when each learning style was compared to kinesthetic, this suggests kinesthetic learning is significantly greater than visual, auditory and read-write modalities within primary school, demonstrated by higher scores in kinesthetic tests completed by participants. Much previous literature also states preference for kinesthetic learning in adults, such as Fleming (2017) whose questionnaire data demonstrates that 27.8% of total population have a preference for kinesthetic learning, as well as Shah et al (2013) who found strongest uni-modal preference to be kinesthetic. This data conducted in primary school appears reflective of that of the general adult population, suggesting permanence in preference, which contradicts Miller's (2001) idea of fluidity within learning style. For teachers it would be important to consider dominant preference of kinesthetic learning within classrooms, assuming many children have high preference for this modality, prompts further use of kinesthetic activities, such as role play, school trips and physically engaging tasks.

Validity of Study Measured by Questionnaire Results

Validity is the question of whether a study measures what it aimed to measure. To increase the validity of this study, as well as the reliability, a questionnaire was issued to teachers/ teaching assistants to complete. This questionnaire offered data which could be compared to test scores and produce a correlation. The results showed medium strength, positive relationship between test scores and teacher perceptions of learning styles for both visual and auditory modalities, and showed strong, positive correlation between both read-write and kinesthetic modalities. This suggests that the research holds good internal validity, as teacher perceptions of learning styles similarly match with actual learning style preference demonstrated by test scores, and therefore this study is reliable. This finding also suggests that teachers within school have good knowledge of which students hold which learning preference, this is an important quality to have as a teacher (Miller, 2001) and one must credit the educators for having individual understanding and knowledge of each child.

Limitations and Future Research

The use of a questionnaire to provide supported internal validity for the experiment strengthened this study. However, limitations are still evident which provides scope for future research. There are methodological issues surrounding this study, firstly due to the nature of kinesthetic learning task, pupils had double the time to conduct the 'learning' part of the test and therefore may have learnt information better due to time rather than learning style. Similarly, they had a shorter amount of learning time for Auditory. This could be the cause of a favor for kinesthetic style/ dislike of auditory style, nevertheless much previous literature supports this finding which allows one to assume the data is correct and reliable and time did not have a large effect on results. There was also a question of whether 'writing' the answers down favored read-write learners, this was not made apparent from results yet it is something which should be considered as a control. In future research one should aim to find tasks for learning which can all be carried out in the same time frame, one should also offer various methods of recalling answers to allow for different preferences without read-write learners having a possible advantage.

This experiment measured uni-modal preferences, yet it is apparent by 6 missing cases, due to having multi-modal preferences which could not be analysed by SPSS, that the study should have taken multi-preferences into consideration. With cases missing bias or shift in data may have been present, causing a change in overall results. Laxman et al. (2014) believes the majority of individuals are multi-modal, with most learning successfully from mixed and balanced blend of all four styles (Fleming and Mills, 1992). It is believed that as many as 86.8% of pupils are multi-modal (Prithishkumar and Michael, 2014), so not taking multi-modal preference into consideration throughout this study is a limitation as without this, results may not be as reliable as first assumed. Another variable which may have an effect on results is the unbalance sample of boys/ girls. Even though no significant differences were found between females and males learning style preference, with 22 boys and 28 girls having analyzable results, a bias may be present. In order to control for any errors in research, future studies should aim to match number of females and males to make results more reliable and replicable.

Future research could also increase sample size from 56 participants (50 cases) to a larger and more varied sample. Current research cannot be generalized to all primary school children in KS1 or KS2, as it is conducted in one area on only two year groups, out of a possible six in primary education. This gives no insight into cross-culture learning style preferences and it is difficult to generalize to the whole of KS1 or KS2 as it is only one year group within each Key Stage. If conducted with whole primary school and in different areas of socio-economic status, data may differ and offer new findings, which will be more suitable to apply to the whole population of primary school pupils.

Conclusion

The present study revealed a number of interesting findings based on learning preferences in primary school. Much previous literature focused on university students or adults, and research based upon solely primary aged children and differences within these pupils was fairly scarce. The study found that KS1 to KS2 pupils learning

preference differs, this is an important concept for educators to take account of as a broad-range of research supports the idea that pupils learn best when teaching style matches preference (Wilson, 1998). Future research suggestions have been made, as although this study demonstrates interesting and innovative findings, the topic of learning styles in primary school is complex. By improving teachers understanding of learning style preferences, maximum achievement of pupils, in many aspects within the classroom is attainable.

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