Full research paper

UNIFICATION OF MULTIMEDIA WITH TECHNIQUES OF ART AND VEDIC APHORISMS FOR DEVELOPMENT OF MATHEMATICAL SKILLS: A STUDY OF INDIAN AND UK SCHOOL STUDENTS

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ABSTRACT

Multimedia programs having a number of elements like Texts, spoken words, sound & music, graphics, animations and still pictures provide different stimuli in their presentations. Art is the field of education that provides a platform for rigorous investigation, representation, expression, and reflection of both scholastic content and the art form itself. The integration of art with other subjects of the school curriculum can open new pathways of learning for students. Vedic Mathematics is an approach to resolve the crisis in education especially in the field of mathematics. It is not simply a collection of new computational techniques; rather, it provides an entirely different approach to the mathematical computation based on pattern recognition. The present paper deals with the development of multimedia packages using techniques of art and Vedic aphorisms on some selected common topics of curriculum of UK and Indian elementary mathematics and the effectiveness of multimedia packages for the development of mathematical skills. The study was conducted using quasi experimental design for research in both countries. The quantitative analysis of data revealed that the multimedia packages developed by using techniques of art and Vedic Aphorisms have significantly improved the mathematical skills of UK elementary school students.

KEYWORDS

Mathematical skills, multimedia, techniques of art, Vedic aphorisms

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Highlights

- *Development of Mathematical Skills with techniques of art and Vedic aphorisms using quasi experimental design.*
- *Multimedia packages developed by using techniques of art and Vedic aphorisms have not been found to be effective in development of mathematical skills of Indian elementary school students.*
- *Techniques of Art when integrated with multimedia have significant effect on the development of mathematical skills of elementary school students of UK.*
- *Multimedia packages with Vedic aphorisms are not effective to develop mathematical skills of UK elementary school students*

INTRODUCTION

Learning through embedded multimedia proves to be superior to the learning in verbal conditions. Lessons or instructions provided by multimedia technology are preferred by learners as well as instructors for better and improved classroom results. All the students have access to technology these days. Computers, internet, cell phones are available all the time for students inside as well as outside the classroom. They speak to others in the language of technology and they are expected to do the same inside the classroom and get the best out of it.

The use of multimedia in the classroom can significantly enhance student's achievements if systematically designed and implemented. Students use the information provided to them through visual and auditory presentations to construct knowledge. Experimental research studies done on multimedia as a strategy to facilitate teaching in the classrooms explored that it helps in imparting the educational material to students effortlessly and has enhanced the trend to use technology and multimedia in education (Ghazzawi, 2002:15). Multimedia has also showed a positive impact on development of cognitive abilities, academic success, understanding and application. Learning through multimedia is always a major concern for mathematics teachers. The mathematical symbols are abstract in nature. Therefore, students cannot realize the characteristics and meanings of these symbols, and then it becomes unreasonable to ask students to recount their arithmetic calculations. As technology is progressing continuously, teaching mathematics using different tools of multimedia is becoming a new and improved way of instruction (Malik and Aggarwal, 2012: 468). Learning is enhanced by the use of multimedia tools like visuals, sound, text and motion. Making use of these visual representations to teach mathematical skills produce positive results for the learner (Flanagan, 2002).

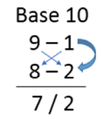
A newspaper article by Clark (2012) reported that there is a mathematics crisis in the UK and the universities are closing down those degree courses which require mathematical skills. The report also revealed that England is one of the few developed countries that are failing to educate their students in mathematics at elementary stage. The authors visited the elementary schools of UK, the teachers of those schools shared that students lack their interest in mathematics and many a times their total achievement gets affected by achievement in mathematics. In Indian elementary schools, the same condition was also prevailing, where the students refused to choose mathematics even at secondary level due to lack of interest in mathematics. After understanding the condition of elementary mathematics in both the countries, authors thought to develop a multimedia package to develop interest and enhance achievement of the students in mathematics using art and vedic aphorisms. The multimedia packages were developed taking into consideration whether these proved systems would be effective in India and UK having different systems of education.

REVIEW OF LITERATURE

Over the last few years, a number of researches have been conducted to investigate the impact of using multimedia tools in learning. Multimedia is a combination of auditory / verbal and visual/pictorial material presented in a systematic way (Mayer, 2012). It may include power point presentation that strengthens deeper understanding using graphics and onscreen text (Mayer and Johnson, 2008: 385), virtual games, computer assisted instructions and multimedia in combination with structured guidance and moreover, reflection technique can foster potentially deep understanding of inexperienced learners (Moreno and Mayer, 2004: 172; Moreno and Mayer, 2005: 127). These multimedia strategies can be used in any content area. Presentation of verbal and visual material e.g. videos integrated with exchanges of ideas are most effective for beginners and learners who learn from visuals. That is why the lessons incorporated with effective video clips are more appropriate for slow learners and under achievers for teaching complex topics and for introductory courses. Undoubtedly all other students and subjects are benefited as well.

The research findings on the effectiveness of videos clips embedded multimedia in classes are very motivating. A number of studies in the specific areas have produced significant results which favors the use of multimedia in classroom teaching (Seago, 2015: 259; Wang and Hartley, 2003:105; Brophy, 2004; Moreno and Valdez, 2007: 194; Borko et al., 2008: 417; Pryor and Bitter, 2008: 2668). Stimuli presented by multimedia using auditory and visuals increases retention, promotes deeper understanding and comprehensive learning.

Vedic Mathematics is the name given to that system in which, mathematics is based on 16 sutras, which are also known as aphorisms. The whole system of Vedic mathematics is interrelated and unified because the most important feature of Vedic mathematics is coherence. This unifying quality makes mathematics easy, pleasurable and encourages uniqueness. The teachers should use sutras or aphorisms of Vedic Mathematics in mathematics class along with other methods which will definitely benefit the students to achieve better and solve the problems in short time. An example of vedic mathematics with the use of one of its aphorisms for multiplication is cited here. The name of the aphorism is '*Nikhilam Sutra'* as given in Indian Vedas. If one wants to multiply 9 with 8, mentally using this aphorism, it is done by choosing a nearest base (base will be the multiple of 10). For these two numbers (9 and 8), base will be 10. Then, the numbers are to be subtracted from the base and write the difference beside the number with minus sign as follows. Then, multiply the right-hand side numbers vertically and write the product below. After this, cross subtract the numbers and the difference below on left hand side as given below:



The Nikhilam Sutra could be extremely helpful for the multiplication of bigger numbers also which are near to the base of multiples of 10.

There is significant reduction in the time duration to solve the problems using Vedic mathematics in basic arithmetic calculations (Krishna Prasad, 2017: 161). Vedic Aphorisms improve the computational skills of the learners in a wide area of problems, ensuring both speed and accuracy because it is strictly based on rational and logical reasoning. Vedic mathematics has proved to put a positive impact on students' performance (Ismail and Sivasubramniam, 2010: 133). The students succeed in completing the long multiplication problems involving tables more than five times correctly after learning the Vedic method. Katgeri (2017: 6772) found that a greater number of problems have been solved by the students accurately with significantly less errors with the use of Vedic mathematics in comparison to traditional method of teaching this subject. Vedic mathematics also improves the skills of concentration and rational thinking which are the vital needs of mathematical training for competitive examinations (Dani, 1993: 236). The knowledge of such methods enables the teachers to be more resourceful to mend the students and improve their talent and creativity.

Schools integrating the arts into the curriculum as part of comprehensive education reform strategy are documenting positive changes in the school environment and student performance (Richard, 2002). The students who are taught with arts possess a greater level of motivation and show regularity in class and become more creative than those students who are not exposed to art activities in the school. Use of arts in the classroom as a way of teaching students opens up the pathways for their success both in the classroom and outside world that lasts for the lifetime (Melnick, Witmer and Strickland, 2011: 154). When art and other creative activities are combined with mathematics, it gives learners and teachers to interact creatively and makes mathematics a subject of inquiry (Björklund and Björkman, 2017: 13). Education of mathematics through art and lively activities is an effective way to get one's hand on between mathematics attitudes and joy of learning and support the students in their achievements in the subject of mathematics (Fenyvesi, Koskimaa and Lavicza, 2017: 107). Creating visual illusions through playful and artistic procedures, holds an exciting pedagogical opportunity for raising students' attention towards mathematics. Mathematics is a subject that always seems to be difficult and boring for most of the students but teaching mathematics can be made interesting and retainable in the minds of pupils using different innovative approaches. One of these approaches is teaching mathematics using techniques of art. Integrating the arts into mathematical experiences bring a creative and enjoyable quality to the learning and often makes it more comprehensible for those who are less inclined towards math. Moreover, Integration of art in teaching and learning process has turned up at frontline in response to the regular deterioration of scores of students (Harlin and Brown, 2007: 3). Artistic process means one makes, does and creates something real. Likewise, these are the most realistic experiences which are essential to learn and enjoy math. If one proceeds from the premise that artistic experiences significantly enhance learning, needless to say then, that students' understanding and appreciation for math will be deepened when it is presented to them in an artistic way. Arts become the encouraging factor of learning when it relates to the basic part of the curriculum as well as Integration of art in teaching makes students enable to effortlessly understand the subject matter, ideas and concepts by connecting discrete curricula with the arts (Fowler, 1996; Krug and Cohen-Evron, 2000: 285). Art brings enjoyment to the lives of those who embrace it. Moreover, the use of painting, dance, theatre, poetry in the mathematics teaching and learning makes its more interesting.

A report by Clark (2012) explains that sub standards of mathematics education from decades had led to a crisis in number skills among students in England and due to this universities are dropping mathematics from their degree courses because the students as well as lecturers are incapable to manage their mathematical skills. The report also claimed that complex problems of mathematics are not easy for the students to tackle with and their teachers are also struggling to teach them mathematics anyway. The reasons for not studying mathematics at A-level were perceived as difficulty in learning and the lack of confidence. These are the main reasons for dropping the subject for most of the students. Apart from these, dislike, boredom and lack of relevance are the other important reasons (Brown, Brown and Bibby, 2008: 3). After looking at mathematics education in other countries, the lessons and qualifications in English schools were 'not fit for purpose'. The report also said that England is just one of the developed nations that fail to educate students in mathematics until the age, that student enters a university. In England, as claimed by the report, only 15 percent students study mathematics as a subject after the age of 16, apart from GCSE candidates who take re-examination in the subject to boost their grades.

Mathematics knowledge and qualifications are increasingly important gateways to further and higher education, for crucial life-skills and in order to respond to economic change, as per the report, But the way mathematics is taught and assessed in England has not always kept pace with these changes or with the needs of learners and has left one in four adults functionally innumerate (Clark, 2012). Educational technology applications for enhancing mathematics achievement in K-12 classrooms using meta-analysis approach also explored problems with previous reviews (Cheung and Slavin, 2013: 88). In the last few decades, undoubtedly, educational technology has benefited the students in mathematics classrooms, but the results are to be interpreted cautiously.

A great deal of differences exists with the procedures of research, inclusion of technology in analysis, as serious methodological problems exist with the evaluation of technology application in mathematics classroom. Some of the other common problems are non-existence of control group, lack of initial equivalence between control and experimental groups, large pretest differences; even with the use of ANCOVA (Analysis of Covariance), the underlying distributions may be fundamentally different, therefore large pre-test difference cannot be adequately controlled (Shadish, Cook and Campbell, 2002) and questionable outcome measures. It is indeed unfortunate that poor methodologies tend to report much higher effect size than those with more rigorous methods (Slavin and Smith, 2009: 500; Slavin and Madden, 2011: 370). The participation rate of the students after 16 and university entrance level mathematics is low across the UK and this has been considered as a serious problem (Noyes and Sealey, 2012; Hillman, 2014). There are few studies that explored that perceived difficulties and lack of confidence are the main reasons for students of the UK to drop out mathematics after their General Certificate of Secondary Education (GCSE) qualification (Brown, Brown and Bibby, 2008: 14). However, Indian education system and learning environment for teaching and learning of mathematics also need significant improvements as difficulties in mathematics begin at an early stage because some students enter in schools with limited amount of number sense (Kaufmann, 2008: 1).

Mathematical skills at elementary level has been recognized as most important skill to become successful in the world of work today at many places around the world. There is a significant gap between the knowledge and skills the students learn in school and the knowledge and skills workers need in workplaces and communities. Therefore, teachers need to promote conceptual understanding by using manipulatives to teach mathematical skills (Maccini and Gagnon, 2000: 2; 2006: 217). Preparation of teaching learning material has emerged as an important factor within school for the development of skills in this subject because change and improvement in the context of using technology in learning environments invite participation, engage children, and offer a sense of success. But the situation is intensified by the fact that most of the teachers lack skills of using technology effectively in their classrooms and the resistance of some teachers towards innovative changing and their persistence in managing of their classes with traditional teaching and learning methods (Tramonti, 2018: 1492). This leads to the under development of the required skills making it an abstract subject and lack of connection of its immediate application in everyday life jeopardizing the importance of connection between scientific topics and reality (Ausubel, 1990). Amalgamation of technology with Vedic aphorisms and art techniques is an interesting way to develop the mathematical skills of the students of elementary classes. The study has been conducted to achieve the following objectives:

1. To develop mathematical skills among Indian elementary school students and elementary school students of UK using techniques of art through multimedia packages.
2. To explore the effectiveness of multimedia packages developed using Vedic Aphorisms for enhancing mathematical skills of Indian elementary school students and elementary school students of UK.
3. To compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art.
4. To compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic aphorisms.

Thus, the objectives of the present study are framed to explore the effectiveness of multimedia packages developed by using techniques of art and Vedic aphorisms and to compare the development of mathematical skills of Indian and UK elementary school students with multimedia packages, the paper addressed the following hypothesis:

1. Mathematical skills of Indian elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms.
2. Mathematical skills of UK elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms.
3. There will be no significant difference in the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art.
4. No significant difference will exist in the development of mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic aphorisms.

MATERIAL AND METHODS

Design and Sample

The study was conducted using Quasi experimental design. The data comprised of 180 students of three elementary schools from UK and India each. 90 students from each country were selected. 30 students from each school of UK and India were the participants of the present study. The grade of students selected for the experiment were 6, 7 and 8 in India and key stage 3 in UK where students are studying in year 7, 8 and 9. Therefore, common grades were decided as 7 and 8 for the present study who are in the age group 11 to 13 years. Students were selected randomly from these school having diversity of students as far their achievement level is concerned. Common topics from the existing mathematics curriculum of both the countries applicable for the age group 11-13 years were selected. First school was taken as control group, second school as experimental group I in which techniques of Art were applied and third school was taken as experimental group II in which Vedic Aphorisms were applied for teaching math in India as well as UK.

Instruments

The multimedia packages using techniques of art and Vedic aphorisms on 6 selected topics of elementary mathematics which were common to Indian and UK curriculum of mathematics for elementary classes & Mathematical Skills Test for elementary school students of India and UK were constructed and standardized by the investigator.

RESULTS

Effectiveness of Multimedia Package using Techniques of Art and Vedic Aphorisms for developing Mathematical Skills among students in India

To find out the effectiveness of multimedia packages using techniques of art and Vedic aphorisms for Indian elementary school students to develop their mathematical skills, the investigator administered a pretest of mathematical skills of elementary students studying in Indian schools. The students were taught topics of elementary mathematics with multimedia packages using techniques of arts and Vedic aphorisms which was then followed by a post-test of mathematical skills. Descriptive statistic for the control and experimental groups has been presented in table 1 and table 2 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Control Group (IC)	9.43	2.694	23
Experimental Group with multimedia packages using techniques of art (IEA)	9.72	2.851	25
Experimental Group with multimedia packages using Vedic (IEV)	6.76	2.851	17
Total	8.85	2.954	65

Table 1: Effectiveness of Multimedia Packages vis a vis Mathematical Skills (India) - Descriptive Statistics, 2019 (Source: own Calculation)

Table 1 depicts that the values of mean and standard deviation of control group are 9.43 and 2.694 respectively, mean and standard deviation of experimental group which was given intervention with multimedia packages using techniques of art are 9.72 and 2.851 respectively and mean and standard deviation of experimental group which was taught with multimedia packages using Vedic aphorisms are 6.76 and 2.538. To covariate the initial scores of Indian elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 2.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	134.51	1	134.51	25.38	<0.001
Main Effect (Treatment)	12.40	2	6.20	1.17	0.317
Explained	323.24	64	5.29		
Residual	5645.00	65			
Total	558.46	64			

Table 2: Effectiveness of Multimedia Packages vis a vis Mathematical Skills for Indian Students, 2019, (Source: own calculation)

It is revealed from the above results that *F* value of 'Method' comes out to be 1.17 and significant value is 0.317. It indicates that significant difference does not exist in mathematical skills of Indian elementary school students with multimedia packages developed by using techniques of art and Vedic aphorisms. The hypothesis which stated that **mathematical skills of Indian elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms** has been rejected. Therefore, multimedia packages developed by using techniques of art and Vedic aphorisms have not been found to be effective for development of mathematical skills of elementary school students of India.

It may be interpreted that multimedia packages developed by using techniques of art and Vedic aphorisms do not have significant effect on development of mathematical skills on Indian elementary school students.

Effectiveness of Multimedia Package using Techniques of Art and Vedic Aphorisms for developing Mathematical Skills in UK

To find out the effectiveness of multimedia package using techniques of art and Vedic aphorisms to develop the mathematical skills of elementary school students of UK, the pretest of mathematical skills was administered on elementary students studying in schools of UK. After the pretest, students were taught topics of elementary mathematics with multimedia packages using techniques of arts and Vedic aphorisms which was then followed by a post-test of mathematical skills. Descriptive statistic for the control and experimental groups has been presented in table 3 and table 4 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Control Group (UC)	10.76	1.690	25
Experimental Group with multimedia packages using techniques of art (UEA)	11.63	2.297	30
Experimental Group with multimedia packages using Vedic (UEV)	9.05	3.031	22
Total	10.61	2.566	77

Table 3: Effectiveness of Multimedia Packages vis a vis Mathematical Skills (UK)-Descriptive Statistics, 2019, (Source: own calculation)

Table 3 shows that the values of mean and standard deviation of control group (UC) are 10.76 and 1.690 respectively, mean and standard deviation of experimental group I (UEA) are 11.63 and 2.297 respectively and mean and standard deviation of experimental group II (UEV) are 9.05 and 3.031. To covariate the initial scores of UK elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 4.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	96.338	1	96.338	22.105	<0.001
Main Effect (Treatment)	57.523	2	28.761	6.600	0.002
Explained	318.143	73	4.358		
Residual	9169.00	77			
Total	500.312	76			

Table 4: Effectiveness of Multimedia Packages vis a vis Mathematical Skills for UK Students, 2019, (Source: own calculation)

It is revealed from table 4 that *F* value of 'Method' comes out to be 6.600 and significant value 0.002 < 0.01 which is significant at 0.01 level of significance which shows the existence of significant difference in mathematical skills of UK elementary school students of Control group (UC), experimental group I (UEA) and experimental group II (UEV). The hypothesis which stated that '**mathematical skills of UK elementary school students will significantly improve with multimedia packages developed by using techniques of art and Vedic aphorisms**' has been accepted. Therefore, multimedia packages developed by using techniques of art and Vedic aphorisms have been found to be effective for development of mathematical skills of elementary school students of UK.

It can be interpreted that multimedia packages developed by using techniques of art and Vedic aphorisms have significant effect on the development of mathematical skills among elementary school students of UK. The findings also reveal that significant value for pre-tests of mathematical skills is <0.01 which means that the difference in Pre-test scores of mathematical skill test have significant effect on experiment manipulation. Therefore, it is obligatory to do the post hoc analysis to find the actual difference between post-test of UC, UEA and UEV. Table 5 shows the post-hoc analysis.

Name of the Group	Name of the Group	Mean Difference	Std. Error	Significance value
UC	UEA	0.967	0.566	0.090
	UEV	1.186	0.621	0.060
UEA	UC	0.967	0.566	0.090
	UEV	2.153*	0.593	0.001
UEV	UC	1.186	0.621	0.060
	UEA	2.153*	0.593	0.001

** significant at 0.01 level of significance*

Table 5: Pairwise Comparison- Dependent Variable: Post Test Scores of Mathematical Skills Test, 2018-2019, (source: own calculation)

Table 7, indicates that mean difference between control group (UC) and experimental group I (UEA) is 0.967, control group (UC) and experimental group II (UEV) is 1.186 and experimental group I (UEA) and experimental group II (UEV) is 2.153. The significant value of UC and UEA is 0.09 > 0.05 which is not significant at 0.05 level of significance, the significant value of UC and UEV is 0.060 > 0.05 which is not significant at 0.05 level of significance whereas the significant value of UEA and UEV is 0.001 < 0.01 which is significant at 0.01 level of significance.

By comparing the means of UEA and UEV, it can be interpreted that multimedia packages developed by using techniques of art are more effective in developing the mathematical skills of UK elementary school students as compared to multimedia packages developed by using Vedic Aphorisms.

Comparison of Mathematical Skills of India and UK students with Multimedia Packages using Techniques of Art

To compare mathematical skills of elementary school students of India and UK with multimedia packages developed by using Techniques of Art, a pretest of mathematical skills was administered by the investigator on elementary students studying in schools of UK and India. Then, the students were taught topics of elementary mathematics with multimedia packages using techniques of arts and followed by a post-test of mathematical skills. Scores of pre-test and post-test of both the experimental groups were calculated and tabulated. The descriptive statistic for experimental group (India) IEA and experimental group (UK) UEA has been presented in table 6 and table 7 reveals the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
IEA	9.72	2.851	25
UEA	11.63	2.297	30
Total	10.76	2.715	55

Table 6: Comparison of Mathematical Skills of Indian & UK students viz a viz Techniques of Art- Descriptive Statistics, 2019 (Source: own Calculation)

Table 6 explains that the values of mean and standard deviation of IEA are 9.72 and 2.851 respectively, mean and standard deviation of UEA 11.63 and 2.297 respectively. To covariate the initial scores of Indian and UK elementary school students

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	64.721	1	64.721	11.880	0.001
Main Effect (vis-à-vis Country)	53.258	1	53.258	9.776	0.003
Explained	283.286	52	5.448		
Residual	6770.000	55			
Total	3.927	54			

Table 7: Mathematical Skills (India and UK) viz a viz Techniques of Art – ANCOVA results, 2019 (Source: own Calculation)

on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 7. It is clear from the above table that *F* value against 'Country' comes out to be 9.776 and sig. value is 0.003 < 0.01 which is significant at 0.01 level of significance. It implies that there exists significant difference in mathematical skills of elementary school students of IEA and UEA. The hypothesis which stated that '**no significant difference in mathematical skills of Indian and UK elementary school students with multimedia packages developed by using techniques of art**' has been rejected. Therefore, it can be interpreted from the above findings that development of mathematical skills of Indian and UK elementary school students with multimedia packages using techniques of art differs significantly.

Table 9 also reveals that significant value for pre-tests of mathematical skills of IEA and UEA is 0.001 < 0.01 which means that the differences in initial scores (Pre-test scores of mathematical skills test) of IEA and UEA have significant effect on experiment manipulation. The post hoc analysis has been presented in table 8.

Name of the Group vis-à-vis Country	Name of the Group vis-à-vis Country	Mean Difference	Std. Error	Significance value
IEA	UEA	1.977*	0.632	0.003
UEA	IEA	1.977*	.632	.003

** Significant at 0.01 level of significance*

Table 8: Pairwise Comparison- Dependent Variable: Post Test Scores of Mathematical Skills Test, 2019, (source: own calculation)

From table 8, it is observed that mean difference between IEA and UEA is 1.997. The significant value of IEA and UEA is 0.003 < 0.01 which is significant at 0.01 level of significance. By comparing the means of IEA and UEA, it can be construed that multimedia packages developed by using techniques of art have improved the mathematical skills of UK elementary school students than to Indian elementary school students.

Comparison of Mathematical Skills with Multimedia Packages developed by using Vedic Aphorisms (India and UK)

To compare the mathematical skills of elementary school students of India and UK with respect to multimedia packages of Vedic Aphorisms, a pretest of mathematical skills was administered by the investigator on elementary students studying in schools of UK and India. After the pretest, students were taught the topics of elementary mathematics with multimedia packages developed using Vedic Aphorisms, which was then followed by a post-test of mathematical skills. Scores of pre-test and post-test of both the experimental groups were calculated and tabulated. The descriptive statistic for experimental group (India) IEA and experimental group (UK) UEA has been presented in table 9 and table 10 discloses the results of analysis of covariance.

Name of the group	Mean	Std. Deviation	*N*
Indian Exp withV	6.76	2.538	17
Uk Exp withV	9.05	3.031	22
Total	8.05	3.017	39

Table 9: Descriptive Statistics of Mathematical Skills of Indian and UK Students viz a viz Vedic Aphorisms 2019 (Source: own Calculation)

From table 9, it is clear that the values of mean and standard deviation of IEV are 6.76 and 2.538 respectively, mean and standard deviation of UEV 9.05 and 3.031 respectively. To covariate the initial scores of Indian and UK elementary school students on their mathematical skills, test of analysis of covariance was applied and the results of univariate test are presented in table 10.

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Significance of *F*
Covariates (pre-test)	103.069	1	103.069	19.231	0.000
Main Effect (vis-à-vis Country)	14.572	1	14.572	2.719	0.108
Explained	192.945	36	5.360		
Residual	2874.000	39			
Total	345.897	38			

Table 10: Mathematical Skills (India and UK) viz a viz Vedic Aphorisms- ANCOVA results, 2019 (Source: own Calculation)

Table 10 reveals that *F* value against 'Country' comes out to be 2.719 and significant value is 0.108 > 0.05, which is not significant at 0.05 level of significance. It infers that there does not exist significant difference in mathematical skills of elementary school students of IEV and UEV. The hypothesis which stated that '**no significant difference will exist in mathematical skills of Indian and UK elementary school students with multimedia packages developed by using Vedic Aphorisms**' has been accepted. Therefore, it can be interpreted from the above findings that development of mathematical skills of Indian and UK elementary school students with multimedia packages using Vedic Aphorisms does not differ significantly.

DISCUSSION

The multimedia packages developed by using techniques of art and Vedic aphorism have not revealed effectiveness for developing mathematical skills of elementary school students of India. According to the investigator, the reason may be that Vedic mathematics and techniques of art are new methods of learning for the students of elementary classes in India. The students are already well accustomed with the traditional methods for developing basic skills in mathematics. Learning something new needs a lot of drill work especially in the subject of mathematics. Although the students were interested in solving the problems of mathematics in their post-test after learning through multimedia, combined with vedic aphorism and techniques of art, still, watching multimedia lessons only once would not have enhanced their mathematical skills and they need more time and practice to become fully acquainted with vedic aphorisms and art techniques for the development of their skills in the subject of mathematics. Due to this reason, the effectiveness of multimedia packages is not proved to be significant in case of elementary school students of India.

The multimedia packages developed by using techniques of art have been effective in developing mathematical skills among elementary school students of UK. During the research, investigator felt that most of the students specially in UK were very much interested in learning mathematics through art. They loved to do activities using colors and were attracted towards the multimedia integrated with techniques of art for learning skills in mathematics. When these students were exposed to the multimedia lessons using art techniques, they quickly picked up and did well in their posttest of mathematical skills.

Using Vedic aphorisms in solving the mathematical problems, the researcher found that more time and practice was required in the case of students of key stage 3 in UK. Due to these reasons, the elementary school students of UK have shown significant improvement in the development of their mathematical skills with multimedia packages developed by using techniques of art, but not with multimedia packages developed by using techniques of Vedic aphorisms.

When Indian and UK elementary school students were compared for the development of mathematical skills using multimedia packages developed by using techniques of art and Vedic aphorisms, the review from researches have explored that students learn better from words and pictures as compared to words alone, because audio visual animations appear to be most effective while presenting concepts or information (Betrancourt, 2005). Putting words, written as well as spoken and pictures (static graphic images), animations and videos make the brain process more in working memory (Sweller, 2005).

The results of the studies conducted by Luzón and León (2015: 127) and Rabkin and Redmond (2006: 60) support the findings of the present study that suitable inclusion of an animation effect in the materials of teaching and learning of mathematical skills can facilitate the cognitive processes that specialize in selecting information, building representation models, and making sense, thus promoting students' learning ability, and use of arts has positive impact on the academic achievement of the students. They also suggested that those students who are struggling in this particular subject could benefit the most from art intervention. These results also support the findings of the present study that the multimedia packages developed by using techniques of art have been found to be more effective as compared to multimedia packages developed by using Vedic aphorisms for developing mathematical skills among elementary students studying in the schools of UK. The results are also supported by Tramonti (2017: 9279) that use of technology combining with art in teaching and learning of mathematics in the classrooms can provide students with digital tools which emphasize the interactivity of learning process, evaluation and construct of new knowledge by stimulating the creativity and understanding the complex relations of mathematics and reality in a better way. The content taught through multimedia helps to illustrate and explain complex concepts in the way that were previously inaccessible through the traditional teaching resources and pedagogies, hence quality of education can be improved using ICT tools. Mathematics taught by using smart class as an ICT tool enhances the retention of elementary school students in the subject of mathematics (Sharma, 2018: 108).

CONCLUSIONS

There are number of ways in which multimedia can be defined. For the present study, multimedia has been defined as the delivery of instructional content in the subject of mathematics using audio, video, pictures and animations. To achieve the objectives of present research, multimedia packages were developed with techniques of art and Vedic aphorisms to find out whether multiple modes of visual and auditory information help the students to develop their basic skills in mathematics subject. Arts have the power to explore the paths of self-knowledge and expression of self and when teachers are trained to use art in any form in their classrooms, the transformation of learning environment occurs.

The integration of art with multimedia to teach mathematics to elementary classes has proved to be effective in development of mathematical skills of UK students as revealed by the results of present study. However, in the case of Indian elementary school students, the development of mathematical skills with multimedia packages using techniques of art and Vedic aphorisms revealed contradictory results. The post-hoc analysis of the present study explored that mathematical skills of UK elementary school students significantly improved with multimedia packages developed by using techniques of art. To the best knowledge of investigator, no research study has been conducted on integration of multimedia with art and vedic aphorisms for the development of mathematical skills of elementary school students of India and UK, although few studies in context to multimedia, vedic mathematics and achievement of students in the subject and use of art to teach and learn mathematics have been quoted in this paper, yet the findings underline the need of further investigation of the subject. Pedagogical methods need to be improved in India and UK to teach the existing curriculum of mathematics using Art and vedic aphorisms so that students' skills in mathematics developed, enhances their overall achievement.

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