INTRODUCTION

Psychologists and Educationists debate the issue of whether intelligence is a single construct or several. According to Gardner (1993) human beings possess a number of distinct intelligences that manifest themselves in different skills and abilities. He referred to them as Multiple Intelligences. Humans apply these intelligences to solve problems, invent processes, and create things.

The theory of multiple intelligences offers seven ways or styles of teaching and learning. In this regard, armed with the knowledge and application of the multiple intelligences, teachers can ensure they provide enough variety in the activities they use so that their pupils’ learning potential can be tapped as much as possible (Berman, 1998).

Multiple Intelligence Theory goes beyond being an intelligence theory; rather it is an educational philosophy showing how students learn and how teachers should teach (Hoerr, 1997). There are numerous studies based on this, such as that by Poole (2000) where clear description of an Multiple Intelligence classroom seems to be helpful in understanding the potential of the theory in practice. In an integrated and cooperative Multiple Intelligence classroom, the teacher employs non-traditional approaches to construction of meaning through a flexible but careful planning. Alghazo, Obeidat, Al-trawneh and Alshraideh (2009) found in their study that the percentages of existence of multiple intelligences in the Social Studies, Arabic language and English language textbooks was acceptable, hence they recommend holding training sessions for the teachers of the first three grades who taught these courses and trained them on accomplishing these intelligences so that they could achieve the goals in the best qualified way. They also recommended putting a scale for the multiple intelligences for each textbook and each grade so that it flowed in a logical way that was suitable with the developmental characteristics of the students.

RATIONALE OF THE STUDY

The application of the Multiple Intelligence theory in teaching provides the teacher with the ability to apply new skills and among the students it improves group learning and academic achievement as suggested by Thabet, (2005). The approach acknowledges the individual differences while enabling students to meet the demands of the lessons. Students are thus able to accomplish their school work and engage well in lesson activities. Moreover, there is a stimulation of their mind, thought processes and interests. In addition, it highlights the individual’s talents and abilities which can be developed for further growth.
Numerous studies have been undertaken with Mathematics as the teaching subject. Douglas, Burton & Durham (2008) undertook an experimental study regarding achievement of eight grade students, Temur (2007) undertook an experimental study on Achievement and Permanency of four grade students and Naoe (2010) undertook a descriptive survey with Mathematics, science and English subjects of fifth grade learners. Similarly, Saban (2011) conducted qualitative descriptive survey with Science and Technology subjects on 4,5,6,7 and 8 Grade teachers and thus concluded that learners could learn better and permanently if they were subjected to this theory. Evidently, students’ performance in different subject areas remarkably improves if activities inspired by the Multiple Intelligence Theory were integrated in the lessons.

Needless to say that, the theory of Multiple Intelligence and its application by teachers to modify their styles to accommodate individual differences among learners, goes a long way in changing the form of the classroom teaching and learning. However there is a scarcity studies that suggest the practical applications of the Multiple Intelligence theory in regular classrooms. How can a teacher integrate the multiple intelligences of the pupils in the teaching of Mathematics? The researcher perceived a need to develop teaching modules that could integrate the multiple intelligences and thereby help students to develop an interest and understanding in Mathematics. The multiple intelligence teaching modules can help the Mathematics teacher to educate their students to be more conscious and reflective in their thinking abilities and in the different methods of learning. Further, it can help teachers to understand the differences which they realize among their students and choose the suitable teaching methods in light of the individual differences between them. Hence the study was planned with the main aim of developing Teaching Modules that could incorporate the multiple intelligences of students in order to study the extent to which Multiple Intelligence Theory can be applied to the mathematics teaching and the conventional teaching method of Mathematics teaching and that using the module based on Multiple Intelligence were also to be compared in a quasi experiment in order to establish the effectiveness of the modules.

RESEARCH QUESTIONS

This study was undertaken to find solutions to the following research questions:

1. Is the Multiple Intelligence Teaching Module effective for improvement of achievement in Mathematics of Eight class students as compared to the conventional method?
2. Is the Multiple Intelligence Teaching Module effective for concept retention in Mathematics of Eight class students as compared to the conventional method?
3. Is the Multiple Intelligence Teaching Module helpful to prevent concept attrition in Mathematics of Eight class students as compared to the conventional method?

**STATEMENT OF THE PROBLEM**
The above questions, when formally expressed, lead to the statement of the problem: 
**Development of Multiple Intelligence Teaching Module in Mathematics for Upper Primary Level.**

**OBJECTIVES OF THE STUDY**
The study was undertaken with the following objectives:

**MAIN OBJECTIVES**
1. To develop Multiple Intelligence Teaching Module in Mathematics for class VIII.

2. To study the effectiveness of Multiple Intelligence Teaching Module in comparison to the conventional method in terms of achievement in Mathematics for class eight girl students.

**SECONDARY OBJECTIVES**
1. To study the concept retention in Mathematics of class eight girls students being taught through Multiple Intelligence Module and students taught through conventional method over a period of time after the termination of treatment.

2. To study the concept attrition in Mathematics of class eight girls students being taught through Multiple Intelligence Module and students taught through conventional method over a period of time after the termination of treatment.

**CONCOMITANT OBJECTIVES**
To develop Criterion Referenced Test in Mathematics for class eight girls students.

**OPERATIONAL DEFINITIONS OF KEY TERMS**
The key terms related to study are:

**Multiple intelligence Teaching Module** – It is the teaching module where the teacher uses the seven areas of intelligences as proposed by Gardner in making the module that is how to teach the particular topic with the help of Gardner’s Multiple Intelligence theory. For the purpose of this study four Multiple Intelligences have been taken viz. Verbal-Linguistic, Logical-Mathematical, Visual/Spatial and Bodily kinesthetic intelligence.
Upper Primary Level –
Upper Primary Level refers to the 6th, 7th and 8th classes of U.P. Board however for this study students of class eight have been taken.

Other terms used in the study:

**Achievement in Mathematics**-
Scores obtained by the eight class students on the criterion referenced test developed by the investigator on the selected chapters of the mathematics syllabus prescribed by the U.P. Board for class eight students.

**Retention of Knowledge**-
This refers to the ability to reproduce and apply the acquired knowledge after a fixed duration of time. Effective retention is one in which the knowledge can be applied to different situations with the same zeal and robustness even after duration of not less than six months. In the present study, long term retention (Bacon and Stewart, 2006) (measured after a period of six weeks) is considered for practical reasons. In the present study it is given by the difference between delayed Post Test and Pre Test scores.

**Attrition of knowledge**
This refers to the slow loss or slow abrasion or gradual wearing off the knowledge with time. It differs from forgetting in the sense that even though in case of attrition the knowledge or information are present in long term memory but it can be accessed in its complete form. It is not forgotten entirely but can be retrieved only partially due to gradual decay or wearing off. In the present study it is given by the difference between delayed post test scores and posttest scores.

**METHODOLOGY**

For this study, Non-randomized pretest-posttest Quasi-experimental design was used.

**POPULATION**

The population for the present study was class eight students studying in Hindi medium, U.P. Board School in Mau city.
SAMPLE

Two intact sections, out of five sections of class VIII of the school that is Section A and C were randomly chosen as the sample of the study. Two section A and C were chosen by coin flipping as the Experimental and Control group respectively. Total of 64 students were selected out of which 32 students are from Experimental group and 32 students are from Control group.

MODULES

8 Modules were developed by the investigator. For standardization, these modules were given to the experts in the Faculty of Education, Banaras Hindu University, Varanasi and Public Mahila Sahar P.G. Degree College, Mau with the instructional objectives and theoretical background. The students of the Experimental group were taught using these modules.

1.12 NULL HYPOTHESIS

To achieve major objective 2 the following null hypothesis are formulated.

H01: There is no significant difference between the achievement in Mathematics of class eight girls students taught through Multiple Intelligence Module and students taught through conventional method at the 0.01 level of significance.

To achieve secondary objectives 1 the following null hypothesis are formulated.

H02: There is no significant difference between the retention of topics in Mathematics of class eight girls students taught through Multiple Intelligence Module and students taught through conventional method at the 0.01 level of significance.

To achieve secondary objective 2 the following null hypothesis are formulated.

H03: There is no significant difference between the attrition of topics in Mathematics of class eight girls students taught through Multiple Intelligence Module and students taught through conventional method at the 0.01 level of significance.

THE EXPERIMENT

The entire experiment consisted of four phases, the pre-treatment phase, treatment phase, the post-treatment phase and delayed post-treatment phase. The steps involved and the various activities performed in each of these phases are summarized in table below:
Table 3  
Schematic Representation of the Experiment

<table>
<thead>
<tr>
<th>S.No</th>
<th>Phase</th>
<th>Duration</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pre-Treatment</td>
<td>1 Day</td>
<td>Both the groups that is Experimental and Control were administered the pre test (to measure achievement)</td>
</tr>
</tbody>
</table>
| 2.   | Treatment       | 27 Hours (41 periods of 40 minutes duration) | Taught the selected chapters to  
Experimental Group  
By Multiple Intelligence Teaching Module  
Control Group  
By Conventional Method |
| 3.   | Post-Treatment  | 2 days, 1 day for each group        | Immediately after the treatment, both the groups that is Experimental and Control were administered Posttest-I (to measure achievement)    |
| 4.   | Delayed Post-Treatment | 2 days, 1 day for each group | After a gap of six weeks from the treatment, both the groups that is Experimental and Control were administered Posttest-II (to measure knowledge-retention and to assess knowledge-attrition) |

i) At the pre-treatment stage  
Pre –treatment was administered in the month of August 2014. This included administering of the pre-test i.e. the achievement test in mathematics on both the groups i.e. experimental group and control group.

ii) At the post-treatment stage  
Immediately after the treatment, the post-test I was administered to both the groups.

iii) At the delayed post-treatment stage  
Six weeks after treatment the posttest-II was administered to both the groups under the same physical condition. All answer sheets were scored on the basis of the scoring key. The marks were tabulated and subjected to statistical analysis.

TOOLS OF DATA COLLECTION  
Criterion Referenced Test in Mathematics was developed by the investigator to assess the achievement of class eight students in Mathematics. There were 50 items based on the selected eight chapters.
DATA ANALYSIS
In order to verify the hypotheses, data were analyzed with the help of the ANOVA, ANCOVA and ‘t’ test.

FINDINGS
Objective wise findings of the study are as follows (All hypotheses have been tested at the 0.01 level of significance):

Findings related to Major Objective 1
A Significant difference was found in the achievement of class eight students in Mathematics taught through Multiple Intelligence Teaching Module and those taught through conventional method \( (F_{y.x}=124.15) \). The experimental group with a mean of posttest scores of 42.906 outperformed the control group with a mean of posttest scores of 33.906.

Findings related to Secondary Objective 1
A Significant difference was found in the mean concept retention gain scores of class eight students in Mathematics taught through Multiple Intelligence Teaching Module and those taught through conventional method \( (t=20.60) \). The experimental group with a mean concept retention gain scores of 24.03 outperformed the control group with a mean concept retention gain scores of 5.28 on the delayed posttest.

Findings related to Secondary Objective 2
A Significant difference was found in the mean attrition values (retention loss) of class eight students in Mathematics taught through Multiple Intelligence Teaching Module and those taught through conventional method \( (t=4.66) \). The experimental group with a mean attrition values (retention loss) of 3.34 was significantly lower when compared to that of the control group with a mean attrition values (retention loss) of 7.718.

CONCLUSION
Based on the findings of the study, it may be concluded that the Multiple Intelligence Teaching Module is significantly more effective than the conventional method in the improvement of achievement in Mathematics, concept retention in Mathematics and for preventing concept attrition (retention loss) in Mathematics of eight class students.
EDUCATIONAL IMPLICATIONS OF THE STUDY

The conclusions based on the finding of the present study lead towards some educational implications for the students, for teachers, for teacher educators and for curriculum developers. However a few implications of the study are given below:

Implications for Students

Multiple Intelligence Teaching Module as an instructional method would be helpful to raise the achievement levels of students. Multiple Intelligence Teaching Module would also be helpful to the students for enhancing retention of topics in their cognitive structure. Multiple Intelligence Teaching Module would also be helpful to the students for preventing attrition (retention loss) of topics.

Implications for Teachers

For teachers Multiple Intelligence Teaching strategy clubbed with other activities would be a better alternative to traditional methods of teaching any subject. Multiple Intelligence Teaching strategy would help the teachers to communicate complex relationships between topics as well as abstract topics effectively to the students and to organize their curriculum systematically and present it effectively. Multiple Intelligence Teaching strategy would also be helpful for the subject teachers to identify the causes of underachievement among students and to remedy them. Teachers can also use Multiple Intelligence Teaching strategy as misconception correction tools. Using student constructed Multiple Intelligence Teaching module teachers can diagnose students’ understanding of topics and can identify the existing misconceptions. Once misconception in students’ cognitive structure are diagnosed, remedial teaching in this direction can also be done.

Implications for Teacher Educators

The present study has direct implications for teacher education programs. It provides an innovative and superior teaching strategy to the teacher educators. The teacher educators need to train the prospective teachers in the construction of Multiple Intelligence Teaching Module so that in future they can effectively apply this method in their classrooms.

Implications for Curriculum Developers

Multiple Intelligence Teaching Module would help in curriculum development and designing. The present study reveals that to learn a concept meaningfully, the students should have acquired the existing sub-concepts and interrelationships among them. Thus the textbooks
should stress on in-depth conceptual knowledge instead of factual, superficial and unrelated knowledge.

**SUGGESTIONS FOR FURTHER RESEARCH**

- Replicated studies to compare the effectiveness of Multiple Intelligence Teaching Module and other teaching methods can be undertaken.
- Replication can be undertaken in ‘Boys only’ schools or in a coeducational school to find out the effectiveness of Multiple Intelligence Teaching Module.
- Similar studies can be conducted taking wider content area not only in Mathematics but also in other disciplines on syllabus of other boards and inter disciplinary courses.
- Similar studies can be conducted at lower and higher levels of education.
- The sample of the present study comprised of intact groups. Studies may be designed in which subjects are randomly assigned to groups.
- Only knowledge, understanding and application based objectives of cognitive domain of Bloom’s taxonomy are considered for the present research. Studies with higher cognitive objectives such as analysis, synthesis and evaluation could be undertaken.
- Studies comparing effectiveness of various teaching methods in various Government/public schools affiliated to CBSE and/or ICSE and/or U.P. Board of Urban and/or rural settings are desirable for making wider generalizations.

**LIMITATIONS OF THE STUDY**

Our conclusions and findings are subject to several limitations.

- The quasi-experimental design (including non-random assignment) employed in the study may be subject to differences between the two sections that are fundamental to the groups but of which the experimenter is unaware. To overcome these differences the two groups were matched on the basis of pre test scores.
- The same instructor taught both sections in back-to-back classes. This raises the possibility of instructor fatigue as an issue that biases. The researcher had taken care of this to some extent by holding three days of each section in the first half of the day and three days in the second half.
REFERENCES


