SUMMARY AND CONCLUSIONS

6.1 The Study in Retrospect
6.2 Major Findings
6.3 Tenability of the Hypothesis
6.4 Conclusions of the Study
6.5 Educational Implications
6.6 Suggestions for Further Research
This chapter gives a brief summary of the study in retrospect which includes the restatement of the problem, objectives of the study, hypotheses of the study and methodology in brief. The main focuses of this chapter are the major findings and conclusions of the study, educational implications of the study and suggestions for further research.

6.1 The Study in Retrospect

The different aspects of the various stages of the present study are presented in the following heads.

6.1.1 Restatement of the Problem

McCormack and Yager Taxonomy is the classification of objectives in which there are five domains, Knowledge, Process, Creativity, Application and Attitude. The topic for investigation is entitled “EFFECTIVENESS OF MCCORMACK AND YAGER TAXONOMY IN TEACHING PHYSICS AT SECONDARY LEVEL”.

6.1.2 Objectives of the Study

1. To find out the Achievement in Physics of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.
2. To find out the Achievement in Physics of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy under the different domains/objectives.

3. To compare the Achievement in Physics of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

4. To compare the Achievement in Physics of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy under the different domains/objectives.

5. To compare the Physics Interest of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

6. To compare the Scientific Attitude of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

7. To compare the Science Creativity of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

8. To compare the Process Skills in Science of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

9. To compare the Metacognitive Awareness of students taught using McCormack and Yager Taxonomy and Bloom’s Taxonomy.

6.1.3 Hypotheses of the Study

The following hypotheses were formulated for the present study.
1. The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

2. The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy under the different domains/objectives.

3. The Physics Interest of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

4. The Scientific Attitude of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

5. The Science Creativity of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

6. The Science Process Skills of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.
7. The Metacognitive Awareness of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

6.1.4 Methodology in Brief

Experimental verification was necessary to determine the effectiveness of McCormack and Yager Taxonomy in teaching Physics to Secondary school students. Thus experimental method was used for conducting the study and the design selected was pre test - post test nonequivalent group design (Best and Kahn, 2004).

Sample selected for the study

The sample for the study consisted of 340 students of Standard-X from eight divisions in four secondary schools of Alappuzha district. Four divisions (one from each school) were considered as experimental group and the other four divisions (one from each school) were considered as the control group. Both the experimental and control groups consisted of 170 students each.

Tools used in the study

The tools used for the study were

1. Raven’s Standard Progressive Matrices
2. Lesson Transcript based on McCormack and Yager Taxonomy
3. Lesson Transcripts based on Bloom’s Taxonomy
Summary and Conclusion

4. Achievement Tests in Physics based on McCormack and Yager Taxonomy and Bloom’s Taxonomy (prepared by the investigator)
5. Physics Interest Inventory (prepared by the investigator)
6. Scientific Attitude Scale (prepared by the investigator)
7. Science Creativity Test
8. Science Process Skill Test (prepared by the investigator)
9. Metacognitive Awareness Inventory

Procedure adopted in the study

Before starting the experimental treatment, the investigator classified the selected students into two groups (four divisions each) by comparing their previous Achievement in Physics and their general mental ability and also with the opinion of the Physics teachers in the concerned schools. Then in both groups Achievement tests, Physics Interest Inventory, Scientific Attitude Scale, Science Creativity Test, Science Process Skills Test and Metacognitive Awareness Inventory were administered as pre-tests. After that the investigator herself conducted classes in both the groups. The Experimental group was taught using McCormack and Yager Taxonomy and the Control group was taught using Bloom’s Taxonomy. After the treatment, all the tests given as pre-tests were administered again to both the groups as post-tests.
**Summary and Conclusion**

**Statistical techniques used**

The scores obtained by the students in the pre-test and post-test were classified, tabulated and subjected to statistical analysis. This includes comparison of mean scores of pre-test scores, post-test scores and gain scores using 't' test with a view to get a formal conclusion of the comparative effectiveness of the treatment. More precise conclusion was arrived at using the technique – Analysis of Covariance.

**6.2 Major Findings**

The important findings that have emerged from the study are

I. Achievement in Physics based on McCormack and Yager Taxonomy

6.2.1 The analysis of the pre-test scores on Achievement in Physics based on McCormack and Yager Taxonomy shows that the critical ratio obtained is 0.83 which is not significant at 0.01 and 0.05 levels. After comparing the post-test scores (CR=13.09) and the gain scores (CR=14) of the Experimental and Control groups with respect to Achievement in Physics, it is revealed that the Experimental and Control groups differ significantly at 0.01 level. The value of critical ratio and the mean score reveals that students in the Experimental group achieved better than the Control group. Thus it can be inferred that the teaching through McCormack and Yager Taxonomy helped the Experimental group to
achieve better than the Control group, taught through Bloom’s Taxonomy.

6.2.2 When comparing the experimental and control group with respect to pre-test and post-test scores using ANOVA, the obtained value of $F_x$ is 0.04 which is not significant. It shows that there is no significant difference between pre-test scores of Experimental and Control groups with respect to their Physics Achievement. The obtained $F_y$ value is 172.96 which is significant at 0.01 level. This shows that the groups differ significantly on Physics Achievement in the post-test scores.

6.2.3 When comparing the experimental and control group with respect to pre-test and post-test scores using ANCOVA, Since the $F_{yx}$ ratio (172.57) is greater than the table value; it is significant at 0.01 level. The significant $F_{yx}$ ratio for the adjusted post-test scores on Achievement in Physics shows that the final mean scores of students in the Experimental group and the Control group differ significantly after they were adjusted for the difference in the pre-test scores.

6.2.4 The difference in adjusted means for post-test scores of the Experimental and Control groups were tested for significance for df 1/337. The obtained 't' value is $t=13.14$ which is significant at 0.01 level. This shows that students taught through McCormack and Yager Taxonomy achieved better than those taught through Bloom’s Taxonomy.
6.2.5 The students in the Experimental Group taught through McCormack and Yager Taxonomy do not differ significantly at 0.05 level, with respect to Gender and Type of school. Since the CR obtained is 0.019, there is no significant difference between boys and girls on Achievement in Physics based on McCormack and Yager Taxonomy. After comparing the Achievement in Physics of Aided and Govt school students in the Experimental group the CR obtained is 0.55. Thus there is no significant difference between Aided and Govt school students in the Experimental group on Achievement in Physics based on McCormack and Yager Taxonomy.

6.2.6 When the pre-test scores on Achievement in Physics (based on McCormack and Yager Taxonomy) under the different domains/objectives were analysed, the CR obtained is not significant at 0.01 or 0.05 levels (Knowledge-CR=0.31, Process–CR=0.91, Creativity-CR=0.28, Application-CR=0.07 and Attitude–CR=0.28). This shows that the Experimental and Control groups do not differ significantly on Achievement in Physics, under the different domains/objectives prior to the treatment.

6.2.7 When the post-test scores of the Experimental and Control groups were compared with respect to Achievement in Physics (based on McCormack and Yager Taxonomy) under the different
domains/objectives CR obtained is significant at 0.01 level (Knowledge-CR=3.67, Process-CR=15.84, Creativity-CR=9.8, Application-CR=5.93) and regarding Attitude (CR=2.35) significant at 0.05 level.

This shows that there is significant difference (at 0.01 level) between the Experimental and Control groups with respect to post-test scores under the domains/objectives- Knowledge, Process, Creativity and Application and (at 0.05 level) Attitude. The mean post-test scores of the two groups reveal that after the treatment the Experimental group achieved better than the Control group. Thus it can be inferred that the Experimental group taught through McCormack and Yager Taxonomy achieved better than the Control group taught through Bloom’s Taxonomy with respect to the different domains/objectives.

6.2.8 When the gain scores of the Experimental and Control groups were compared with respect to Achievement in Physics (based on McCormack and Yager Taxonomy) under the different domains/objectives, CR obtained is significant at 0.05 level (Knowledge-CR=2.37) and at 0.01 level (Process-CR=6.66, Creativity-CR=7.41, Application-CR=5.89 and Attitude-CR=4.19).

This shows that there is significant difference between the Experimental and Control groups with respect to gain scores under the different domains/objectives- Knowledge, Process, Creativity,
Application and Attitude. The mean gain scores of the two groups reveal that after the treatment the Experimental group achieved better than the Control group. Thus it can be inferred that the Experimental group taught through McCormack and Yager Taxonomy achieved better than the Control group taught through Bloom’s Taxonomy with respect to the different categories of domains/ objectives based on McCormack and Yager Taxonomy.

6.2.9 After the analysis the obtained value of Fx for the different domains/objectives is Knowledge-Fx=0.23, Process-Fx=0.12, Creativity-Fx=0.12, Application- Fx=0.00, Attitude- Fx=0.31, which is not significant even at 0.05 level. This shows that there is no significant difference between pre-test scores of the experimental and control groups on Achievement in Physics under the different domains/ objectives-Knowledge, Process, Creativity, Application and Attitude. The obtained Fy value for the different categories of domains/objectives is Knowledge-Fy =18.67,Process - Fy =34.39,Creativity- Fy =96.4,Application- Fy =35.40,Attitude- Fy =15.18,which is significant at 0.01 level. This shows that the groups differ significantly on Achievement in Physics under the different categories of domains/ objectives.

6.2.10 While computing ANCOVA, the obtained Fyx ratio on Achievement in Physics under the different domains/objectives is
Knowledge-Fyx=18.84, Process-Fyx=34.38, Creativity-Fyx=34.38, Application-Fyx=35.3, Attitude- Fyx =15.4, which is greater than the table value and is significant at 0.01 level. The significant Fyx ratio for the adjusted post-test scores on Achievement in Physics under the different categories of domains/objectives shows that the final mean (post test) scores of students in the Experimental and the Control groups differ significantly after they were adjusted for the difference in the pre-test scores.

6.2.11 The difference in adjusted means for post-test scores on Achievement in Physics under the different domains/objectives of the Experimental and Control groups were tested for significance for df 1/337. The obtained 't' value is Knowledge- t=4.34, Process-t=5.86, Creativity-t=5.86, Application- t=5.94, Attitude- t=3.93 which is significant at 0.01 level. Thus it is clear that the Experimental and Control groups differ significantly with respect to Achievement in Physics (based on McCormack and Yager Taxonomy) under the different domains/objectives-Knowledge, Process, Creativity, Application and Attitude.

Thus it can be inferred that the students in the Experimental Group taught through McCormack and Yager Taxonomy have better
Achievement in Physics under the different domains/objectives than the Control Group, taught through Bloom's Taxonomy.

II. Achievement in Physics based on Bloom’s Taxonomy

6.2.12 The critical ratio obtained after comparing the pre-test scores on Achievement in Physics of the Experimental and Control groups is 0.82 which is not significant at 0.01 and 0.05 levels. The critical ratio obtained after comparing the post-test scores (CR=16.27) and gain scores (CR=16.83) of the Experimental and Control groups with respect to Achievement in Physics, revealed that the Experimental and Control groups differ significantly at 0.01 level. The value of critical ratio and the mean score of the post-test and gain scores reveals that the Experimental Group taught through McCormack and Yager Taxonomy achieved better than the Control Group, taught through Bloom’s Taxonomy.

6.2.13 From the analysis using ANOVA, the obtained value of Fx is 0.04 which is not significant. It shows that there is no significant difference between pre-test scores of Experimental and Control groups with respect to their Achievement in Physics based on Bloom’s Taxonomy. The obtained Fy value is 165.69 which is significant at 0.01 level, which shows that the groups differ significantly in their post-test scores with respect to Achievement in Physics.
6.2.14 While computing ANCOVA, Since the $F_{yx}$ ratio is greater than the table value, it is significant at 0.01 level ($F_{y.x} = 165.57, P<0.01$). The significant ratio for the adjusted post-test shows that the final mean scores of students in the experimental and control groups differ significantly after they are adjusted for the difference in the pre-test scores.

6.2.15 The difference in adjusted means for post-test scores of the Experimental and Control groups was tested for significance for df 1/337. The obtained 't’ value ($t=11.25$) is significant at 0.01 level. This shows that students in the Experimental group, taught through McCormack and Yager Taxonomy achieved better than the students in the Control group, taught through Bloom’s Taxonomy.

6.2.16 The students in the Experimental Group taught through McCormack and Yager Taxonomy do not differ significantly at 0.01 level, on Achievement in Physics based on Bloom’s Taxonomy with respect to Gender and Type of school. Since the CR obtained is 0.09, there is no significant difference between boys and girls on Achievement in Physics based on Bloom’s Taxonomy. The CR obtained after comparing the Achievement in Physics of Aided and Govt school students in the Experimental group is 0.64. Thus there is no significant difference between Aided and Govt school students in the Experimental group on Achievement in Physics based on Bloom’s Taxonomy.
6.2.17 When the pre-test scores on Achievement in Physics (based on Bloom’s Taxonomy) under the different categories of objectives were analysed, the CR obtained is not significant even at 0.05 level (KnowledgeCR=1.19, ComprehensionCR=1.12, ApplicationCR=0.20, AnalysisCR=1.33, Synthesis-CR= 1.12 and Evaluation–CR=1.28). This shows that the Experimental and Control groups do not differ significantly on Achievement in Physics, under the different categories of objectives before starting the treatment.

6.2.18 When the post-test scores of the Experimental and Control groups were compared with respect to Achievement in Physics (based on Bloom’s Taxonomy) under the different categories of objectives, the CR obtained is Knowledge-CR=1.38, Comprehension– CR=3.74, Application- CR=4.67, Analysis- CR=3.51, Synthesis- CR= 4.82 and Evaluation–CR=4.55. This shows that there is significant difference (at 0.01 level) between the Experimental and Control groups with respect to post-test scores under the categories of objectives- Comprehension, Application, Analysis, Synthesis and Evaluation. The mean post-test scores of the two groups reveal that after the treatment the Experimental group achieved better than the Control group except at Knowledge level.

Thus it can be inferred that the Experimental group taught through McCormack and Yager Taxonomy achieved better than the Control group
taught through Bloom’s Taxonomy with respect to the different categories of objectives except at Knowledge level.

6.2.19 When the gain scores of the Experimental and Control groups were compared with respect to Achievement in Physics (based on Bloom’s Taxonomy) under the different categories of objectives, CR obtained is Knowledge-CR=1.01, Comprehension–CR=2.83, Application - CR=4.47, Analysis-CR=4.21, Synthesis-CR=5.49 and Evaluation–CR=3.69.

This shows that there is significant difference (at 0.01 level) between the Experimental and Control groups with respect to gain scores under the categories of objectives-Comprehension, Application, Analysis, Synthesis and Evaluation and there is no significant difference (at 0.01 level) between the Experimental and Control groups with respect to gain scores under the category of objective Knowledge. Thus it can be inferred that the Experimental group taught through McCormack and Yager Taxonomy achieved better than the Control group taught through Bloom’s Taxonomy with respect to the different categories of objectives except at Knowledge level.

6.2.20 After the analysis the obtained value of Fx for the different categories of objectives is Knowledge Fx=0.15, Comprehension Fx=0.25, Application -Fx=0.00, Analysis-Fx=0.25, Synthesis-Fx=0.04,
Evaluation-Fx=0.15, which is not significant even at 0.05 level. This shows that there is no significant difference between pre-test scores of the Experimental and Control groups on Achievement in Physics under the categories of objectives Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.

The obtained Fy value for the different categories of objectives is Knowledge Fy=1.24 (not significant at 0.01 level) and Comprehension-Fy =13.6, Application- Fy =22.26, Analysis -Fy=12.68, Synthesis - Fy =23.14, Evaluation- Fy =20.55( significant at 0.01 level). This shows that the groups differ significantly on Achievement in Physics under the different categories of objectives except at Knowledge level.

6.2.21 While computing ANCOVA, the obtained Fyx ratio on Achievement in Physics under the different categories of objectives is Knowledge - Fyx =1.09, Comprehension- Fyx =13.52, Application - Fyx =22.19, Analysis - Fyx =12.81, Synthesis - Fyx =23.11, Evaluation - Fyx =20.48, which is greater than the Table value and is significant at 0.01 level except at the Knowledge level. The significant Fyx ratio for the adjusted post-test scores on Achievement in Physics under the different categories of objectives shows that the final mean (post test) scores of students in the Experimental and the Control groups differ significantly after they were adjusted for the difference in the pre - test scores.
6.2.22 The difference in adjusted means for post-test scores on Achievement in Physics under the different categories of objectives of the Experimental and Control groups were tested for significance for df 1/337. The obtained 't’ value is Knowledge- $t=1.06$, Comprehension - $t=3.68$, Application - $t=4.71$, Analysis - $t=3.58$, Synthesis - $t=4.81$, and evaluation- $t=4.53$ which is significant at 0.01 level except at Knowledge level. Thus it is clear that the Experimental and Control groups differ significantly with respect to Achievement in Physics (based on Bloom’s Taxonomy) under the categories of objectives Comprehension, Application, Analysis, Synthesis and Evaluation. From analysis, it can be inferred that the students in the Experimental Group taught through McCormack and Yager Taxonomy have better Achievement in Physics than the Control Group taught through Bloom’s Taxonomy under the different categories of objectives except at Knowledge level.

### III. Interest in Physics

6.2.23 After comparing the pre-test scores the critical ratio obtained is 1.01 which reveals that there is no significant difference between the Experimental and Control groups with respect to Physics Interest at 0.01 level and 0.05 level. The critical ratio obtained after comparing the post-test scores (CR=11.2) and gain scores (CR=10.49) of the Experimental and Control groups with respect to Physics Interest shows that the
Experimental and Control groups differ significantly at 0.01 level. The value of critical ratio and the mean scores reveals that the Experimental group taught using McCormack and Yager Taxonomy showed more Interest in Physics than the Control group, taught using Bloom’s Taxonomy.

6.2.24 From the analysis using ANOVA, the obtained value of Fx is 0.49 which is not significant. It shows that there is no significant difference between pre-test scores of the Experimental and Control groups with respect to their Physics Interest. The obtained Fy value is 125.48 which is significant at 0.01 level. This shows that the groups differ significantly in their post-test scores on Interest in Physics.

6.2.25 From the analysis using ANCOVA, the Fyx ratio is greater than the table value, it is significant at 0.01 level (Fy.x = 135.42, P<0.01). The significant ratio for the adjusted post-test scores show that the final mean score of students in the experimental and control groups differ significantly after they are adjusted for difference in the pre-test scores.

6.2.26 The difference in adjusted means for post-test scores on Interest in Physics of the Experimental and Control groups were tested for significance for df 1/337. The obtained ‘t’ value (t=11.65) is significant at 0.01 level. After treatment, there is significant difference between the Experimental and Control groups with respect to Interest in Physics. Thus
it can be inferred that McCormack and Yager Taxonomy based teaching helped the students in the Experimental group to show more Interest in Physics.

IV. Scientific Attitude

6.2.27 After comparing the pre-test scores of the Experimental and Control groups with respect to Scientific Attitude, the critical ratio obtained is 0.92 which shows that there is no significant difference between Experimental and Control group at 0.01 level and 0.05 level. The critical ratio obtained after comparing the post-test scores (CR=14.13) and gain scores (CR=33.91) of the Experimental and Control groups with respect to Scientific Attitude shows that the Experimental and Control group differ significantly at 0.01 level. The value of critical ratio and the mean scores reveal that the Experimental group taught using McCormack and Yager Taxonomy showed more Scientific Attitude than the Control group taught using Bloom’s Taxonomy.

6.2.28 From the analysis using ANOVA, the obtained value of Fx is 1.06 which is not significant. It shows that there is no significant difference between pre-test scores of the Experimental and Control groups with respect to their Scientific Attitude. The obtained Fy value is 200.55 which is significant at 0.01 level. This shows that the groups differ significantly on Scientific Attitude in their post-test scores
While computing ANCOVA, the Fyx ratio is greater than the table value, it is significant at 0.01 level \( (F_{y.x} = 201.53, P<0.01) \). The significant ratio for the adjusted post-test scores show that the final mean scores of students in the experimental group and the control group differ significantly after they were adjusted for the difference in the pre-test scores.

The difference in adjusted means for post-test scores on Scientific Attitude of the Experimental and Control groups were tested for significance for df 1/337. The obtained ‘t’ value \( (t=14.22) \) is significant at 0.01 level. After treatment, there is significant difference between the Experimental and Control groups with respect to Scientific Attitude. Thus it can be inferred that McCormack and Yager Taxonomy based teaching helped the students in the Experimental group to show more Scientific Attitude.

V. Science Creativity

After comparing the pre-test scores of the Experimental and Control groups with respect to Science Creativity, the critical ratio obtained is 0.81 which shows that there is no significant difference between Experimental and Control group at 0.01 level and 0.05 level. The critical ratio obtained after comparing the post-test scores (CR=7.89) and gain scores (CR=31.81) of the Experimental and Control groups with
respect to Science Creativity shows that the Experimental and Control
groups differ significantly at 0.01 level. The value of critical ratio and the
mean scores reveal that the Experimental group taught using
McCormack and Yager Taxonomy showed more Science Creativity than
the Control group, taught using Bloom’s Taxonomy.

6.2.32 From the analysis using ANOVA, the obtained value of Fx is 0.01
which is not significant. It shows that there is no significant difference
between pre-test scores of the Experimental and Control groups with
respect to their Science Creativity. The obtained Fy value is 62.42 which
is significant at 0.01 level. This shows that the groups differ significantly
in their post-test scores on Science Creativity.

6.2.33 While computing ANCOVA, the Fyx ratio is greater than the table
value, it is significant at 0.01 level (Fy.x=68.31, P<0.01). The significant
ratio for the adjusted post-test scores show that the final mean scores of
students in the experimental group and the control group differ
significantly after they were adjusted for the difference in the pre-test
scores.

6.2.34 The difference in adjusted means for post-test scores on Science
Creativity of the Experimental and Control groups were tested for
significance for df 1/337. The obtained ‘t’ value (t=8.27) is significant at
0.01 level. After treatment, there is significant difference between the
Experimental and Control groups with respect to their Science Creativity. Thus it can be inferred that McCormack and Yager Taxonomy based teaching helped the students in the Experimental group to show more Science Creativity.

VI. Science Process Skills

6.2.35 After comparing the pre-test scores of the Experimental and Control groups with respect to Science Process Skills, the critical ratio obtained is 0.96 which shows that there is no significant difference between Experimental and Control group at 0.01 level and 0.05 level. The critical ratio obtained after comparing the post-test scores (CR=11.78) and gain scores (CR=20.32) of the Experimental and Control groups with respect to Science Process Skills shows that the Experimental and Control group differ significantly at 0.01 level. The value of critical ratio and the mean scores reveal that the Experimental group taught using McCormack and Yager Taxonomy gained more Process Skills in Science than the Control group, taught using Bloom’s Taxonomy.

6.2.36 From the analysis using ANOVA, the obtained value of Fx is 3.09 which is not significant. It shows that there is no significant difference between pre-test scores of the Experimental and Control groups with respect to their Science Process Skills. The obtained Fy value is 138.81
which is significant at 0.01 level. This shows that the groups differ significantly on Science Process Skills in the post-test scores

6.2.37 While computing ANCOVA, Since the Fyx ratio is greater than the table value, it is significant at 0.01 level (Fy.x = 141.96, P<0.01). The significant ratio for the adjusted post-test scores show that the final mean scores of students in the experimental group and the control group differ significantly after they were adjusted for the difference in the pre-test scores.

6.2.38 The difference in adjusted means for post-test scores on Science Process Skills of the Experimental and Control groups were tested for significance for df 1/323. The obtained 't' value (t=11.97) is significant at 0.01 level. After treatment, there is significant difference between the Experimental and Control groups with respect to their Science Process Skills. Thus it can be inferred that McCormack and Yager Taxonomy based teaching helped the students in the Experimental group to show better performance in Science Process Skills.

VII. Metacognitive Awareness

6.2.39 After comparing the pre-test scores of the Experimental and Control groups with respect to Metacognitive Awareness, the critical ratio obtained is 0.41 which shows that there is no significant difference between Experimental and Control group at 0.01 level and 0.05 level. The
critical ratio obtained after comparing the post-test scores (CR=7.29) and

gain scores (CR=31.81) of the Experimental and Control groups with

respect to Metacognitive Awareness shows that the Experimental and

Control group differ significantly at 0.01 level. The value of critical ratio

and the mean scores reveal that the Experimental group taught using

McCormack and Yager Taxonomy gained more Metacognitive

Awareness than the Control group, taught using Bloom’s Taxonomy.

6.2.40 From the analysis using ANOVA, the obtained value of Fx is 0.46

which is not significant. It shows that there is no significant difference

between pre-test scores of Experimental and Control groups with respect

to their Metacognitive Awareness. The obtained Fy value is 47.06 which

is significant at 0.01 level. This shows that the groups differ significantly

on Metacognitive Awareness in the post-test scores.

6.2.41 While computing ANCOVA, Since the Fyx ratio is greater than

the table value, it is significant (Fy.x = 51.19, P<0.01). The significant

ratio for the adjusted post-test scores show that the final mean scores of

students in the experimental group and the control group differ

significantly after they were adjusted for the difference in the pre-test

scores.

6.2.42 The difference in adjusted means for post-test scores on

Metacognitive Awareness of the Experimental and Control groups were
tested for significance for df 1/323. The obtained 't' value (t=7.16) is significant at 0.01 level. After treatment, there is significant difference between the Experimental and Control groups with respect to their Metacognitive Awareness. Thus it can be inferred that McCormack and Yager Taxonomy based teaching helped the students in the Experimental group to facilitate their Metacognitive Awareness.

6.3 Tenability of the Hypotheses

The tenability of the hypotheses are stated below.

Hypothesis I

The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

The findings 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.2.12, 6.2.13, 6.2.14, 6.2.15, 6.2.16 shows that the Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.

Hypothesis II

The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy under the different domains/objectives.
The findings 6.2.6, 6.2.7, 6.2.8, 6.2.9, 6.2.10, 6.2.11, 6.2.17 shows that the Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy under the different domains/objectives. The findings 6.2.18, 6.2.19, 6.2.20, 6.2.21 and 6.2.22 shows that the Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy under the different categories of objectives except the object - Knowledge. Hence the above hypothesis is partially substantiated.

**Hypothesis III**

_The Physics Interest of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy._

The findings 6.2.23, 6.2.24, 6.2.25, 6.2.26 indicates that the Physics Interest of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.

**Hypothesis IV**

_The Scientific Attitude of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy._
Finding number 6.2.27, 6.2.28, 6.2.29, 6.2.30 shows that Scientific Attitude of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.

**Hypothesis V**

*The Science Creativity of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.*

Findings 6.2.31, 6.2.32, 6.2.33, 6.2.34 shows that the Science Creativity of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.

**Hypothesis VI**

*The Science Process Skill of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.*

Findings 6.2.35, 6.2.36, 6.2.37, 6.2.38 indicates that the Science Process Skills of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.
Hypothesis VII

*The Metacognitive Awareness of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.*

Finding numbers 6.2.39, 6.2.40, 6.2.41, 6.2.42 indicates that the Metacognitive Awareness of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. Hence the above hypothesis is substantiated.

6.4 Conclusions of the Study

The major conclusions that emerged from the study are given below.

1. The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy.

2. The Achievement in Physics of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy under the different domains/objectives.

3. The Physics Interest of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. It can be concluded that McCormack
and Yager Taxonomy based teaching helped the students to show more Interest in Physics.

4. The Scientific Attitude of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. It can be inferred that McCormack and Yager Taxonomy based teaching helped the students to show more Scientific Attitude.

5. The Science Creativity of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. It can be concluded that McCormack and Yager Taxonomy based teaching helped the students to show more Science Creativity.

6. The Science Process Skills of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. It can be concluded that McCormack and Yager Taxonomy based teaching helped the students to show better performance in Science Process Skills.

7. The Metacognitive Awareness of students taught using McCormack and Yager Taxonomy is significantly higher than that of those taught using Bloom’s Taxonomy. It can be concluded that McCormack and Yager Taxonomy based teaching helped the students to show more Metacognitive Awareness.
6.5 Educational Implications

The findings of the study revealed that teaching of Physics using McCormack and Yager Taxonomy helped to enhance Achievement in Physics, Interest in Physics, Scientific Attitude, Science Creativity, Science Process Skills and Metacognitive Awareness of Secondary school students.

Preparing children to meet the demands of an uncertain future, however may require a shift in educational focus from the content to the process of learning. Not only do children need to be able to think, but they need to exercise control over their own thinking.

The country needs people with the capacity to think independently, logically and critically and also to create knowledge. This need can be fulfilled if the McCormack and Yager Taxonomy based teaching is introduced along with other modern methods. This process of teaching and learning create in children an urge to learn new developments and motivate them to acquire information and knowledge about new techniques.

According to McCormack and Yager Taxonomy, students are not passive listeners and have an important place in the learning process. It takes the student to a position where learning becomes a pleasant experience and also to regulate their learning process in positive direction.
McCormack and Yager Taxonomy enhance the Science Process Skills and Scientific Attitude of students. This provides opportunity for the learners to actively participate in group discussions while learning. Various skills such as observation, classification, interpretation of data etc. develops in students. This has also helped the learners to improve their attitude towards science. They are automatically elevated to high esteem of self satisfaction due to the feeling of immediate reinforcement and are encouraged to think reflectively.

One of the major highlight in McCormack and Yager Taxonomy is that it helped in enhancing scientific creativity of students. So the teacher should assist parents to encourage the creative experiences of their children by discussion, experimenting, discovering and constructing, by being tolerant to divergent ideas, by guiding them to investigate in order to discover ideas for themselves and by sharing stimulating experience with them. The child's striving for independence, for recognition and for reward are some of the assets of creative personality that the parents should realize.

McCormack and Yager Taxonomy provides the learner autonomy, promotes co-operative learning, collaborative learning and encourages students to bring social experience to the classroom. It also enhances the metacognitive awareness of learners.
Teachers should be encouraged to apply McCormack and Yager Taxonomy while teaching the subject and also teachers should be oriented to the theory and practice associated with it. At present, most of the teachers are not aware of the details of this taxonomy. Hence McCormack and Yager Taxonomy based teaching should be incorporated in the syllabus for teacher training and provision should be made in teacher education programme to explore the possibilities of practicing innovative taxonomies such as McCormack and Yager Taxonomy.

This taxonomy of teaching gives teachers enough freedom to choose activities and materials of varying forms and this helps in planning classroom activities according to the needs and interest of the pupil. By using such taxonomy, teachers can improve the knowledge and understanding of the students in any subject.

Even in the absence of teachers, these types of programme can engage the students and prevent the wastage of their time. NCERT and SCERT, SSA, Central and State Government agencies can make use of the service of outstanding teachers at the National as well as the State level so that the expertise of meritorious teachers can be made available to the students in far flung areas.

Faculty improvement programmes namely orientation classes, refresher courses, seminars and workshops should be organized for the teachers to familiarize with various aspects of McCormack and Yager
Taxonomy. The study further points out the need for providing opportunities to teachers for getting trained in the use of modern technological devices like computers and internet, so as to implement interactive and creative strategies in the classroom scenario.

Model lesson transcripts strictly following McCormack and Yager Taxonomy shall be prepared by a team comprises of experts in the field and made available to teachers so that teachers can apply judiciously this taxonomy in the classroom setting.

Every school should provide ample library facilities with internet connectivity for the teachers and students to get acquaintance with latest theory and practice that are experimenting across the globe. At the same time, it should be monitored properly that all are utilizing the facilities to produce maximum output.

Since the available books on McCormack and Yager Taxonomy are written by foreigners, ordinary and legible books for the use in Indian classroom may be published and made available in the school libraries. The infrastructure facilities and science lab in schools are not sufficient for implementing new methods and strategies. Therefore more facilities should be provided in all secondary schools for effective Physics teaching.

Keeping the results of the study in mind appropriate steps should be taken by NCERT, SCERT and other agencies related to the quality of
education regarding the development of teaching based on McCormack
and Yager Taxonomy for all subjects.

Research should be conducted to develop effective and feasible
instructional strategies for teaching based on McCormack and Yager
Taxonomy and for developing more valuable tools in teaching Physics
based on this Taxonomy.

The results of the present study have very significant value in the
field of education. The findings of the study can bring about
revolutionary changes from the perspective of the learner, the teacher, the
educational system and the society at large.

**Suggestions for Further Research**

The investigator is of the view that the present study opens up
many new avenues for conducting more studies in future in the field of
education. Some suggestions for the possible lines in which further
research can be carried out are given below.

1. The present study is conducted at secondary level. This study needs
to be repeated for different educational levels such as Primary and
Higher Secondary and the same study can be conducted to other
school subjects.

2. This study can be repeated for a large sample for longer duration
representing all districts in the state to ensure the validity of the
results.
3 A study on developing materials for transacting science curriculum by adapting this technique of teaching can be conducted.

4 Studies can be conducted to find the Effectiveness of McCormack and Yager Taxonomy on under, average and high achievers.

5 A survey of teacher's attitude towards teaching using McCormack and Yager Taxonomy and its effects on students can be conducted.

6 A study can be undertaken to evaluate the student’s views and reactions towards the use of McCormack and Yager Taxonomy in teaching and learning.

7 To make comparison more meaningful and comprehensive, a variety of tests meant for measuring the specific goals associated with the McCormack and Yager Taxonomy should be developed, got standardized and used for collecting required data in the treatment.

8 A research project on how McCormack and Yager Taxonomy could be incorporated into the instructional process of learning Physics could be undertaken by different agencies.