CHAPTER V

SUMMARY, CONCLUSIONS, AND SUGGESTIONS

5.1. The Study in Retrospect

Evaluation of the Revised Biology Curriculum at High School Level in the Constructivist Perspective and Practice.

5.1.2. Objectives of the Study

1. To evaluate the revised biology curriculum at high school level in the constructivist perspective as perceived by State Resource Group (SRG) with respect to the dimensions such as
   i) Nature and principles of constructivism
   ii) Nature of strategies of classroom transaction
   iii) Role of teacher
   iv) Nature of student activities and
   v) Nature of strategies of assessment.

2. To analyse textbooks of revised biology curriculum at high school level in the constructivist perspective as perceived by the SRG for the subject of biology.

3. To study the practises and problems of students at high school biology classrooms in the constructivist perspective in the dimensions such as
i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction

iv) Nature of group activity and

v) Nature of strategies of assessment.

4. To compare the mean scores of practises and problems of students at high school biology classrooms in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of strategies of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as

i) Boys and girls

ii) Rural and urban school students

iii) High achievers and low achievers and

iv) Aided, government and unaided school students.

5. To study the practises and problems of biology teachers at high school level in the constructivist perspective in the dimensions such as

i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction
iv) Nature of group activity and

v) Nature of strategies of assessment.

6. To compare the mean scores of practises and problems of biology teachers at high school level in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of strategies of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as

i) Rural and urban school teachers

ii) Aided, government and unaided school teachers

iii) Qualified, academically more qualified, and professionally more qualified teachers

iv) Less experienced, experienced, and more experienced teachers and

v) Less aged, aged, and more aged teachers.

7. To study the correlation between practises of students with practises of biology teachers at high school level in the constructivist perspective in the dimensions such as

i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction

iv) Nature of group activity and
v) Nature of strategies of assessment

8. To study the correlation between problems of students with problems of biology teachers at high school level in the constructivist perspective in the dimensions such as

i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction

iv) Nature of group activity and

v) Nature of strategies of assessment.

5.1.3. Hypotheses of the Study

1. There exists a significant difference in the mean scores of practises and problems of students at high school biology classrooms in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of strategies of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as

i) Boys and girls

ii) Rural and urban school students

iii) High achievers and low achievers and
iv) Aided, government and unaided school students.

2. There exists a significant difference in the mean scores of practises and problems of biology teachers at high school level in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of strategies of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as

i) Rural and urban school teachers

ii) Aided, government and unaided school teachers

iii) Qualified, academically more qualified, and professionally more qualified teachers

iv) Less experienced, experienced, and more experienced teachers and

v) Less aged, aged, and more aged teachers.

3. There exists a significant relationship between practises of students and practises of biology teachers at high school level in the constructivist perspective in the dimensions such as

i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction

iv) Nature of group activity and
4. There exists a significant relationship between problems of students with problems of biology teachers at high school level in the constructivist perspective in the dimensions such as

i) Role of teacher

ii) Nature of student activities

iii) Nature of strategies of classroom transaction

iv) Nature of group activity and

v) Nature of strategies of assessment.

5.1.4. Research Design and procedure

The research design and procedure is described as method, population, sample, tools, collection of data, and statistical treatment of data as follows.

5.1.4.1. Method

Normative survey method was used in the present study.

5.1.4.2. Population

The population of the present study was State Resource Group for the subject of biology, all schools, all students, and all biology teachers of Thrissur Revenue District.
5.1.4.3. Sample

The sample consisted of 16 Resource Persons from the State Resource Group (SRG) representing one resource person from 14 districts of Kerala and 2 Core SRG members from State Core SRG, 120 teachers, teaching in standard VIII, IX and X, and 960 IX\textsuperscript{th} standard students from different schools of Thrissur Revenue District. Due representation was given to each strata of teachers and students such as government, aided, unaided, male, female, rural and urban using proportionate stratified random sampling technique.

5.1.4.4. Tools

For the present study the investigator developed and used five tools as

1. A Philosophical, Psychological, and Sociological Preference Analysis Scale (PPSPAS) to collect data from SRG members

2. A Score card namely Evaluation Scale for Constructivist Biology Textbook (ESCBT) to analyse the biology textbooks at high school level

3. A Questionnaire to collect data from high school teachers about the Practises and Problems of Teachers (QPPT) in the constructivist biology classrooms

4. A Questionnaire to collect data from high school students about the Practises and Problems of Students (QPPS) in the constructivist biology classrooms and

5. Interview Guides to collect data from selected biology teachers and students at high school level.
5.1.4.5. Collection of Data

The data were collected from 16 SRG members, 120 teachers and 960 students using the tools described above. The midterm examination scores for the subject of biology also was collected to consider the achievement of students. The biology curriculum was studied based on the perspectives of constructivism. The textbooks for the standard of VIII, IX and X were examined using schemes developed by the investigator. The data so gathered were triangulated with in-depth interviews to corroborate the emerging findings.

5.1.4.6. Statistical Treatment of Data

The tabulated data were subjected to objective-wise analysis using Statistical Package for Social Sciences (SPSS). The statistical techniques used for the study were Percentage Analysis, Test of Normality, Homoscedasticity, t-test, One-way ANOVA, Correlation (Pearson Product Moment), and Univariate Analysis of Variance.

5.2. Major Findings and Conclusions of the Study

5.2.1. Evaluation of Philosophical, Psychological, and Sociological Preferences of High school Biology Curriculum

Philosophical, psychological, and sociological aspects of constructivism are reflected in the high school biology curriculum with respect to the dimensions: (1) Nature and principles of constructivism (91%), (2) Strategies of curriculum transaction (69%), (3) Role of teacher (91%), (4) Nature of student activities (69%), and (5)
Strategies of assessment (71%) as emphasized in the constructivist paradigm. The data indicate that the philosophical, psychological, and sociological aspects of constructivism are reflected in the high school biology curriculum at a better level.

5.2.2. Analysis of High school Biology Textbooks

The dimensions of textbook examined are: authenticity of the textbook (99%), organisation (97%), content (99%), presentation (95%), accuracy (98%), readability (98%), adaptability (98%), use of teaching aids (91%), descriptions (95%), and appearance of the textbook (91%). The data confirm that the high school biology textbooks highly reflect qualities of a constructivist textbook.

5.2.3. Practises of High School Students in the Constructivist Biology Classrooms

The mean value for the constructivist practises of students in the high school biology classrooms is 30.85 whereas the maximum possible score is 123. It indicates that the students were deprived of better constructivist practises in the high school biology classrooms. The mean values obtained for the constructivist practises for subgroups of students were boys (30.21), girls (31.49), rural school students (25.97), urban school students (35.70), low achievers (30.30), high achievers (31.40), government school students (37.99), aided school students (29.01), and unaided school students (25.59). This indicates that all the subgroups of students were also deprived of better constructivist practises in the high school biology classrooms. The mean values and maximum possible scores for all dimensions of constructivist practises such as role of teacher 7.40 whereas the maximum possible score 20, nature of student activities 9.18
whereas the maximum possible score 27, strategies of classroom transaction 9.55 whereas the maximum possible score 25, nature of group activity 2.81 whereas the maximum possible score 8, and strategies of assessment 1.85 whereas the maximum possible score 13 indicate that the constructivist practises are impoverished in the high school biology classrooms.

5.2.4. Comparison of Mean Scores of Measures of Practises of High School Students in the Constructivist Biology Classrooms

The mean scores of rural and urban high school students in the dimension role of teacher differ (t-value, 9.869) significantly (p < .01 level) in the constructivist practises in the biology classrooms. The students of urban high schools experience better constructivist practises in the dimension, role of teacher in the biology classrooms. The mean scores of students such as boys and girls (t-value, .537), low achievers and high achievers (t-value, .128) did not differ significantly in their constructivist practises in the dimension, role of teacher in the high school biology classrooms. The mean scores of students belonging to government, aided and unaided schools differ significantly (F, 21.865) in their constructivist practises in the dimension, role of teacher in the high school biology classrooms at p < .01 level. The results of multiple comparisons indicate that students belonging to government high schools experience better constructivist practises in the biology classrooms pertaining to the role of teacher when compared to students of aided and unaided schools.

The observations of the interview confirm that the dimension role of teacher was not executed as constructivist curriculum envisages. The responses of students indicate
that most of the teachers were not humane in nature irrespective of management, locale, age, teaching experience, and qualification. Only students from one urban government school responded positively about their biology teacher. In their words “she is good, approachable and lovable in nature”; “all teachers desirably adopt the behaviour of our biology teacher”; “she behaves like a mother and support us in all manner”; and “we feel happy and comfortable with her.”

5.2.5. Problems of High School Students in the Constructivist Biology Classrooms

The students face serious problems in high school biology classrooms as the obtained mean value is 48.64 out of the possible score 72. The mean values for all the subgroups of students such as boys 48.76, girls 48.52, rural school students 51.68, urban school students 45.60, low achieving students 49.46, high achieving students 49.82, government school students 45.84, aided school students 46.89, and unaided school students 53.18 also indicate that all subgroups face serious problems in the high school biology classrooms. The mean values for all dimensions such as role of teacher 5.95 out of the possible score 11, nature of student activities 6.18 out of the possible score 9, strategies of classroom transaction 23.19 out of the possible score 33, nature of group activity 8.99 out of the possible score 14 and strategies of assessment 4.34 out of the possible score 5 also substantiate the problems of students in the high school biology classrooms. The mean values of all dimensions of problems of students in the high school biology classrooms were very high. The problems of students especially in the dimensions such as nature of student activity, nature of group activity, and strategies of assessment are extremely high.
5.2.6. Comparison of Mean Scores of Measures of Problems of High School Students in the Constructivist Biology Classrooms

The mean scores of boys and girls (t-value, 2.996), rural and urban school students (t-value, 7.089), low achieving and high achieving students (t-value, 4.202) differ, in their problems in the dimension, role of teacher significantly at p < .01 level in the high school biology classrooms. The students belonging to government, aided, and unaided schools differ (F, 6.415) significantly at p < .01 level in the problems of students in the dimension, role of teacher in the high school biology classrooms. The students of unaided schools face more problems when compared to government and aided school students in this dimension. The mean scores of rural and urban school students and low achieving and high achieving students differ (t-value, 10.153; 2.291) in their problems in the dimension, strategies of classroom transaction significantly at p < .01 and p < .05 level in the high school biology classrooms respectively. The students belonging to the strata of rural schools and low achievers face more problems in the dimension, strategies of classroom transaction. The boys and girls do not differ (t-value, .346) in their problems in the dimension, strategies of classroom transaction. The mean scores of students belonging to government, aided, and unaided schools differ (F, 86.321) significantly in their problems related to strategies of classroom transaction in the high school biology classrooms at p < .01 level. The result of multiple comparisons reveals that the students of unaided schools face more problems with respect to strategies of classroom transaction when compared to government and aided schools.

Observations of the interview confirm that the dimension nature of student activities clearly prove that no importance is given either for scientific processes or for
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the organic nature of students. It indicates that the classroom processes are entirely
teacher centred. The strategies prevalent in the high school biology classrooms are not in
accordance with constructivist paradigm. Scope for observation, experimentation,
project, field trip, and seminar are not given appropriate weightage. The very method
observation is found totally neglected. The experiments are for the name sake and are
demonstrated by teachers only. There are schools in which students do not have any
practice in conducting experiments. Even the teachers do not make use of microscopes
for any purpose related to the process of teaching. The projects are given as to collect
pictures or description on some objects/materials/topics and are not in connection with
units under consideration.

There was a general observation that instead of using constructivist strategies
teachers depends on some guidebooks such as Labour India and School Master for
teaching and giving notes. In the words of students “everyday he starts class with advice
and spoils half of the period”, “we sleep everyday in the class as we are last benchers”,
and “we learn only because of threat of stick”.

Disappointing evidences are obtained in connection with nature of group activity
and strategies of assessment. In every school groups are formed in the beginning of the
year and no group works are assigned to students. Some teachers make them sit in group
for explaining textbook matter. When assessment practises are considered, no indication
of peer assessment and self assessment is reported from any school under consideration.
In the allotment of CE grades students reflected their dissatisfaction towards their biology
teachers. The criteria used for allotment of CE grades, is also very interesting. In their
words, “s/he gives CE grades based on character/behaviour, discipline, obedience, beauty of students, and marks obtained in the term examinations”.

The analysis of evidences in the dimension role of teacher itself contribute a give a clear notion regarding the reflection of constructivist principles in the high school biology classrooms. They are - - “(1) we start shivering when we see him, (2) he always addresses us as careless and beat without reason, (3) she always gets angry and scolds everyone, (4) we think that she has some mental disorder, (5) we never see her with a smile, (6) she has no personality, (7) he is a ‘moradan’ (stubborn), (8) she didn’t have any quality of a teacher, (9) she is a ‘moota’ (bed bug), (10) who appointed him as a teacher?, (11) she shows more care on high achieving students, (12) he is a ‘beekaran’ (terrorist), (13) she is not a woman as she is so cruel, (14) she is not friendly and likes only high achievers, (15) shows partiality to slow learners and high achievers, (16) she makes all problems in the biology class, (17) she is unpredictable in her behaviour, (18) she always waiting to get a reason to scold and beat, (19) she always threatens us using the words Transfer Certificate (T.C), seminar, and project, (20) she was born with a stick, and (21) we are treated as caged animals.”

5.2.7. Practises of High School Teachers in the Constructivist Biology Classrooms

The mean value for the constructivist practises of teachers in the high school biology classrooms is 54.74 whereas the maximum possible score is 90. When considering all strata of teachers the practises in the high school biology classrooms were found constructivist as the respective mean values ranges from 50.67 to 61.00 (the maximum possible score for constructivist practises is 90.00). The constructivist
practises of teachers related to the four dimensions were found satisfactory according to the reports of teachers. The mean values for the respective dimensions were 12.68 for role of teacher (the maximum possible value is 18), 11.05 for nature of student activities (the maximum possible value is 16), 9.32 for nature of group activity (the maximum possible value is 14), and 11.00 for strategies of classroom transaction (the maximum possible value is 17). But in the case of strategies of assessment, obtained mean value is 11.50 which is low compared to maximum score 24. The results indicate that constructivist practises of teachers in connection with all dimensions can be considered as better to some extent except the dimension of strategies of assessment.

As the quantitative data do, observations from the interview not substantiate the reflection of constructivist practises in the high school biology classrooms. No evidence is obtained from any teacher about the practises in the dimensions, role of teacher, nature of student activities, strategies of classroom transaction, nature of group activity and strategies of assessment except from an urban government high school. It is also interesting to note that all teachers aroused same complaint. In their words, “I explained everything but the stuff is bad, without stick no one can control them, and if we give freedom they summer sault/decapitate.”

5.2.8. Problems of High School Teachers in the Constructivist Biology Classrooms

There are problems for teachers in the constructivist high school biology classrooms as the obtained mean value is 38.98 whereas the maximum possible score is 64.00. The mean values for all the subgroups of teachers based on locale, type of school, teaching experience, qualification, and age ranges from 33.77 to 41.61 which also
indicate problems in the high school biology classrooms. The mean values for five dimensions also indicate constructivist problems for teachers in the high school biology classrooms. The mean value for role of teacher is 6.35 (maximum possible value is 11.00), for the nature of student activities is 6.57 (maximum possible value is 9.00), for the nature of group activity is 12.11 (maximum possible value is 19.00), for the strategies of classroom transaction is 11.33 (maximum possible value is 20.00), and strategies of assessment is 2.63 (maximum possible value is 5.00). This indicates that there are problems for teachers in the constructivist high school biology classrooms.

5.2.9. Correlation between Measures of Practises of High School Students and Teachers in the Constructivist Biology Classrooms

There was no significant positive or negative relationship (r ranges from -.004 to .288) between the practises of students and teachers in all dimensions of constructivist practises considered for the study and it was low. Overall, there was no strong positive or negative correlation between practises of teachers and practises of students. This indicates that though teachers claim that they giving better constructivist practises to students the responses of the students made it clear that it was not true. And it reveals that the practises in the high school biology classrooms were not in tune to constructivist paradigm.

5.2.10. Correlation between Problems of High School Students and Teachers in the Constructivist Biology Classrooms

There was a positive correlation between the problems of teachers in the dimension, nature of student activities and problems of students in the dimension, role of
teacher, (2) problems of teachers in the dimension, nature of group activities and problems of students in the dimension, role of teacher and strategies of assessment, and (3) problems of teachers in the dimension, strategies of classroom transaction and problems of students in the dimension, role of teacher as coefficient of correlation ranges from \( r = < .45 \) to \( > .616 \), and \( p \) values significant at .01 level. This agreement in constructivist problems among teachers and students is a clear indication of impoverished constructivist atmosphere and related problems prevailing in the high school biology classrooms.

There was a positive correlation between (4) problems of teachers in the dimension, nature of student activities and problems of students in the dimension, strategies of assessment, (5) problems of teachers in the dimension, nature of group activity and problems of students in the dimension, strategies of classroom transaction, (6) problems of teachers and students in the dimension, strategies of classroom transaction as coefficient of correlation ranges from \( < .368 \) to \( > .415 \), and \( p \) values significant at .05 level. This congruence in problems among teachers and students is also indicates that the high school biology classroom processes are not in tune with perspectives of constructivism.

There was a negative correlation between (7) problems of teachers in the dimension, nature of group activity and problems of students in the dimension, nature of student activities \( (r = -.366) \), (8) problems of teachers in the dimension, strategies of classroom transaction and problems of students in the dimension, nature of student activities \( (r = -.398) \) as the \( p \) values significant at .05 level. This indicates that there were
incongruence in the experiences of students and teachers’ arguments in connection with nature of group activity, strategies of classroom transaction, and nature of student activities.

5.2.11. **Univariate Analysis of Variance of Measure of Practises of High School Students in the Constructivist Biology Classrooms**

The univariate analysis of variance tested the effects of locale and gender on practises of students (considering achievement as a covariate) in the dimensions such as role of teacher, nature of student activities, strategies of classroom transaction, nature of group activity, and strategies of assessment. Results indicated a significant main effect for locale, $F (1, 954) = 98.454, p < .01$ in the dimension role of teacher, $F (1, 955) = 127.393, p < .01$ in the dimension nature of student activities, $F (1, 954) = 99.196, p = < .01$ in the dimension strategies of classroom transaction, $F (1, 955) = 57.525, p = < .01$ in the dimension nature of group activity, and $F (1, 955) = 18.425, p = < .01$ in the dimension strategies of assessment. This indicates that the constructivist practises in the dimensions role of teacher, nature of student activities, strategies of classroom transaction, nature of group activity, and strategies of assessment are not same for rural and urban school students.

There was no significant main effect for gender as the F values not significant at p value .05 level in the five dimensions considered for the study except the dimension nature of student activities $[F (1, 955) = 4.610, p = < .05]$. This indicates that constructivist practises in the dimensions such as role of teacher, strategies of classroom transaction, nature of group activity, and strategies of assessment are same for boys and
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girls. The constructivist practices in the dimension nature of student activities are
different for boys and girls.

The two main effects were qualified, however, by a significant interaction
between the two factors (gender*locale), F (1, 954) = 11.746, p < .01 in the dimension
role of teacher, F (1,955) = 4.794, p < .05 in the dimension nature of student activities, F
(1, 954) = 13.822, p < .01 in the dimension strategies of classroom transaction, F (1, 955)
= 4.715, p < .05 in the dimension nature of group activity, and F (1, 955) = .057, p > .05
in the dimension strategies of assessment. The significance of main effects of locale and
interaction effects of gender and locale on five dimensions of constructivist practices is
clearly substantiates the real effects of constructivist practices in the high school biology
classrooms when achievement is controlled as a covariate.

5.2.12. Univariate Analysis of Variance of Measure of Problems of High School
Students in the Constructivist Biology Classrooms

The univariate analysis of variance tested the effects of locale and gender on
problems of students (considering achievement as a covariate) in the dimensions such as
role of teacher, nature of student activities, strategies of classroom transaction, nature of
group activity, and strategies of assessment. Results indicated a significant main effect
for locale, F (1, 955) = 55.409, p < .01 in the dimension role of teacher, F (1, 955) =
100.188, p = < .01 in the dimension strategies of classroom transaction, and F (1, 955) =
83.944, p = < .01 in the dimension nature of group activity. This indicates that the
problems in the dimensions role of teacher, strategies of classroom transaction, and
nature of group activity are not same for rural and urban school students.
There was no significant main effect for locale, F (1, 955) = .715, \( p > .05 \) in the dimension nature of student activities, and F (1, 955) = 2.381, \( p = > .05 \) in the dimension strategies of assessment. This indicates that problems in the dimensions nature of student activities, and strategies of assessment are same for rural and urban school students.

There was no significant main effect for gender as the F values were not significant at \( p \) value \( .05 \) level for problems in the five constructivist dimensions considered for the study except the dimension role of teacher \([F (1, 955) = 10.899, p = < .01]\). This indicates that problems in the dimensions nature of student activities, strategies of classroom transaction, nature of group activity, and strategies of assessment are same for boys and girls. The problems in the dimension role of teacher, is different for boys and girls.

The two main effects were qualified, however, by a significant interaction between the two factors (gender*locale), F (1, 955) = 4.890, \( p < .05 \) in the dimension role of teacher, and F (1, 954) = 5.775, \( p < .01 \) in the dimension strategies of classroom transaction except F (1, 955) = .623, \( p > .05 \) in the dimension nature of student activities, F (1, 955) = .148, \( p > .05 \) in the dimension nature of group activity, and F (1, 955) = .221, \( p > .05 \) in the dimension strategies of assessment. The significance of main effects of locale and interaction effects of gender and locale on five dimensions clearly substantiates the real effects of constructivist problems in the high school biology classrooms when achievement is controlled as a covariate.
5.3. Tenability of the Hypotheses

The data provided sufficient evidence to decide the validity of the hypotheses set for it. An attempt has been made to examine the validity of the hypotheses. The four hypotheses set for the study were examined for the tenability in the light of above findings.

The first hypothesis states that “There exists a significant difference in the mean scores of practises and problems of students at high school biology classrooms in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as i) Boys and girls, ii) Rural and urban school students, iii) High achievers and low achievers, and iv) Aided, government, and unaided school students.” This hypothesis is not substantiated with all dimensions of constructivist practises considered for the study except in the dimension role of teacher in the subgroups of rural and urban school students and aided, government, and unaided school students. This reveals that constructivist practises are not normally distributed among high school biology classrooms of Thrissur district and no significant difference was found in the gender, locale, achievement, and type of schools.

When considering the problems of students at high school biology classrooms this is not substantiated except the dimensions role of teacher and strategies of classroom transaction. This is applicable to the subgroups of boys and girls, rural and urban students, and low achievers and high achievers with respect to the dimension role of
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teacher and rural and urban school students, and high achievers and low achievers with respect to strategies of classroom transaction. This reveals that problems are not normally distributed among students at high school biology classrooms and any significant difference in the gender, locale, achievement and type of schools in the dimensions nature of student activities, nature of group activities, and strategies of assessment.

The second hypothesis states that “There exists a significant difference in the mean scores of practises and problems of teachers at high school biology classrooms in the constructivist perspective in the dimensions role of teacher, nature of student activities, nature of classroom transaction, nature of group activity, and nature of strategies of assessment in the sub groups such as i) Rural and urban school teachers, ii) Aided, government and unaided school teachers, iii) Qualified, academically more qualified, and professionally more qualified teachers, iv) Less experienced, experienced, and more experienced teachers and v) Less aged, aged, and more aged teachers.” This hypothesis is not substantiated with all dimensions of constructivist practises of teachers in all sub-groups considered for the study.

The third hypothesis states that “There exists a significant relationship between practises of students and practises of biology teachers at high school level in the constructivist perspective in the dimensions such as role of teacher, nature of student activities, nature of classroom transaction, nature of group activity, and nature of strategies of assessment.” This hypothesis is not substantiated with all dimensions of constructivist practises of teachers and students. This reveals that though teachers claim
that they were using better constructivist practises in the high school biology classrooms the responses of students made it clear that it is not true.

The fourth hypothesis states that “There exists a significant relationship between problems of students and problems of biology teachers at high school level in the constructivist perspective in the dimensions such as role of teacher, nature of student activities, nature of classroom transaction, nature of group activity, and nature of strategies of assessment.” This hypothesis is substantiated in most of the dimensions of problems of students and problems of teachers in the high school biology classrooms. The congruence between role of teacher with nature of student activities, role of teacher and strategies of assessment with nature of group activity, role of teacher with strategies of classroom transaction, strategies of assessment with nature of student activities, and nature of group activity with strategies of classroom transaction of problems of students and problems of teachers respectively indicates that high school students face serious problems in constructivist biology classrooms. The incongruence between the nature of student activities with nature of group activity and nature of student activities with strategies of classroom transaction of problems of students and problems of teachers respectively indicates that teachers’ practises are not in tune with students’ experiences. The inconsistency indicates that teachers do not make attempts to assess how well they implemented components of constructivism in their classrooms.

The tenability of hypotheses is consistent with the studies of Savasci and Berlin (2012), Milner, Templin and Czerniak (2011), and Tobin and McRobbie (1996). These studies reflect that gender was not a predictor of constructivist learning (Milner, Templin
and Czerniak, 2011), grade level may be another factor that influences teacher implementation of classroom practises related to constructivism, whole-class activities are most frequently observed in high school biology classrooms and interaction between teacher and students are more dominant than interactions among students (Savasci & Berlin, 2012), and teachers in the high schools may employ a more content-centred, teacher-centred, approach reflective of their goals and beliefs in transmission, efficiency, rigor, and examination preparation (Tobin & McRobbie, 1996).

The findings open a way to take serious concerns regarding various aspects of dimensions of constructivism. Some of them are - - (1) Student could learn from each other by discussing ideas and concepts, school science should be relevant to student lives outside of school, and teacher perceptions and beliefs influence constructivist practises (Savasci & Berlin 2012), (2) Life science laboratories are an asset to scientific investigations that promote higher student motivation and learning strategy use, mistakes are seen as positive, and use of time and norms of engagement in the classroom are seriously taken to implement constructivist curriculum (Milner, Templin and Czerniak, 2011), (3) Life science laboratories can provide all students with enriching learning opportunities resulting in transformative, aesthetic science education (Pugh & Girod, 2007), and effective science education is an experience that learners want to be part of, rather than something that they have to be part of (Alsop, Bencze & Pedretti, 2005).

The findings also raise discussion regarding neglecting the suggestions of NCF (2005) and KCF (2007) such as - - (1) Provision for children to ask questions, (2) Involvement of students in all the activities and at all stages of teaching-learning process,
(3) Encouraging environment in the classroom, (4) Interaction between student and teacher, with peers and others, (5) Assessment is interwoven with teaching learning process etc., The studies in the dimension of assessment conducted by Lumadi (2013), Davis and Neitzel (2011), and Swaffield (2011) also relevant in this context.

The observations such as - - (1) self-regulated learning (Pintrinch, Marx & Boyle, 1993; Pintrinch, 2000), (2) constructivist-based practises encourage student to constantly assess how activities are helping them gain understanding and so, by questioning themselves and their strategies, students in the constructivist classroom ideally become “expert learners” giving them ever-broadening skills to keep learning (Educational Broad Casting Corporation, 2004) and (3) good science programmes require access to the world beyond classroom, and it is necessary to endorse life science laboratories as a viable and integral aspect of the science curriculum (National Research Council, 1996).

5.4. Educational Implications of the Study

5.4.1. Philosophical, Psychological, and Sociological Preferences of High School Biology Curriculum

The position papers for the subject of biology prepared by State Council of Educational Research and Training (SCERT) may be revisited and cross matched with National Curriculum Framework (NCF, 2005) and Kerala Curriculum Framework (KCF, 2007) to ensure philosophical, psychological, and sociological principles in the high school biology curriculum. The drawbacks may be rectified by giving/preparing guidelines, manual, or arranging empowerment programmes for the stakeholders. Proper
attention may be given to strategies of curriculum transaction, nature of student activities, and strategies of assessment as these dimensions were found somewhat weak when compared to other dimensions such as nature and principles of constructivism and role of teacher. It is desirable to give provisions to give year-wise additions in the curriculum according to the growth and necessity of developments in the discipline of biology. It is necessary to ensure the constructivist perspectives in the handbooks and textbooks of biology at high school level.

5.4.2. High school Biology Textbooks

It is desirable to give proper attention to maintain the constructivist quality of high school biology textbooks by providing some improvements in some dimensions such as use of teaching aids and appearance of the textbooks. It is necessary to consider features of international level textbooks such as new versions of Biological Science Curriculum Study (BSCS), and Nuffield Curriculum Projects. The handbooks of biology may be raised to the level of comprehensive reference materials for the teachers. As in BSCS and Nuffield Curriculum Projects the biology textbooks may be graded according to the levels of students or as option such as biology related to social life, basic conceptual schemes, and concepts related to professional dimensions. The workbooks and laboratory manuals also may be developed considering all levels of students.

5.4.3. Practises and problems of High School Students in the Constructivist Biology Classrooms

It is desirable to arrange comprehensive empowerment programmes for equipping teachers to discharge their duties as constructivist teachers. The National Council of
Educational Research and Training (NCERT) may ensure the convergence of Regional Institute of Education (RIE), State Council of Educational Research and Training (SCERT), Kerala State Council for Science, Technology and Environment (KSCSTE), educational departments of universities, colleges of teacher education (Institutes of Advanced Studies in Education-IASEs), and National Council for Teacher Education (NCTE) for addressing issues pertaining to the problems of curriculum transaction in the high school level. It is desirable to keep the norms and guidelines of National Curriculum Framework for Teacher Education (NCFTE) by these agencies through arranging in-service teacher education programmes for high school biology teachers. SCERT can prepare guidelines, action plan, and modules for ensuring constructivist approach in high school biology classrooms according to the need and necessity of the state. The responsibility can be shared by university education departments and IASEs.

The monitoring system established in the state, district, and sub district level may be strengthened for ensuring the quality of constructivist practises in the high school biology classrooms. The Quality Improvement Programme (QIP) cell of Department of Public Instruction (DPI), Deputy Director of Education (DDE), District Educational Officers (DEO), Assistant Educational Officers (AEO), and Local Self Government (District Panchayath, Block Panchayath & Gramma Panchayath) level convergence may be encouraged to ensure this. The Directorate of Higher Secondary School Education may be approached to establish a ‘leading school system’ to share the resources and expertise to raise the standard of high school education.
The assessment strategies are to be revisited to address the problems in Continuous and Comprehensive Assessment and Evaluation (CCA & CCE) strategies. The science club secretaries of the district may be directed to give adequate guidelines for biology teachers in the use of various devices for classroom transaction, better strategies for group activities, and strategies for self-assessment, peer-assessment, and group-assessment. DPI and SCERT may execute this with convergence.

The problems of students in the high school biology classrooms may be discussed in Public Advisory Committee (PAC) of the district under the auspicious of District Panchayath. District Institute of Education and Training (DIET) can prepare adequate programmes and materials for addressing the problems in this connection as per the need and necessity of the district.

Under the auspicious of DPI and Rashtriya Madhyamik Siksha Abhiyan (RMSA), SCERT may be directed to prepare a comprehensive assessment manual for the subject of biology giving emphasis to process-assessment, self-assessment, and peer-assessment. The emphasis may be given to easy implementation of assessment strategies through digital work sheets, and rating scales. This may supplement the assessment manual prepared by SCERT in 2005.

It is advisable to develop an in house monitoring system in every school through self-reporting (teachers and students), discussion in School Resource Group (SRG), listing problems, developing strategies for improvement, implementing them, analysis of results, and documenting findings. This may be adapted as a self-regulatory, self-
maintaining, and self-sustainable one than the external system of monitoring. The heads of the schools may be directed to report the innovative practises of internal monitoring in the monthly conferences conducted at DDE/DEO level.

An association of biology teachers may be organised at state level/district level for on-site, on-line (through developing blogs), and periodic gathering for supporting and empowering themselves academically. Its function may be a collaborative effort for long term/short term action researches, sharing digital resources, and conducting science congress in which presentation of findings of try-outs, action researches and biological projects of students/teachers can be made. This in house monitoring and innovative practises of practicing teachers may contribute feedback to the curriculum reform/revision and effective transaction of biology curriculum.

5.5. Suggestions for Further Research

The study provides some guidelines regarding the areas which need further research. Some of the areas are - - (1) Relationship between biology teachers espoused beliefs/perceptions on constructivist curriculum and classroom implementation, (2) Teacher views of the nature of science, teacher content and Pedagogical Content Knowledge (PCK) based on constructivism, (3) Effective strategies for group work (4) Alternative forms of assessment versus authentic assessment for constructivist high school biology classrooms, (5) Self-assessment strategies as a tool for self regulation of learning and effective teaching, (6) Peer-assessment strategies for effective learning, (7) ‘From concept maps to concept cartoons’ an alternate way to effective biology learning.