CURRICULUM AUDIT: AN ANALYSIS OF CURRICULUM ALIGNMENT AT SECONDARY LEVEL IN PUNJAB

By

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2015

Curriculum evaluation
change.

thesis.

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By

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Reg. No: 68/FSS/PHDEDU/S11

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education at Department of Education, Faculty of Social Sciences,

INTERNATIONAL ISLAMIC UNIVERSITY, ISLAMABAD

2015

بسم الله الرحمن الرحيم

DEDICATION

Dedicated to my wife AMNA BATOOL whose support kept me intact.

APPROVAL SHEET

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FORWARDING SHEET

This thesis entitled "**Curriculum audit: An analysis of curriculum alignment at secondary level in Punjab**" submitted by **Mr. Abdul Jabbar Bhatti** in partial fulfilment of PhD degree in Education has been completed under my guidance and supervision. I am satisfied with the quality of student's research work.

Professor Dr. N. B. Jumani
Supervisor

CURRICULUM AUDIT: AN ANALYSIS OF CURRICULUM ALIGNMENT AT SECONDARY LEVEL IN PUNJAB

STATEMENT OF UNDERSTANDING/DECLARATION

I, ABDUL JABBAR BHATTI Reg. No.68-FSS/PHDEDU/S11 and student of PhD Education, International Islamic University Islamabad do hereby solemnly declare that the thesis entitled '"**Curriculum audit: An analysis of curriculum alignment at secondary level in Punjab**" submitted by me in partial fulfilment of PhD degree is my original work, except where otherwise acknowledged in the text, and has not been submitted or published earlier and so not in future, be submitted by me for any degree from this University or institution.

Signature: Jabbar

Abdul Jabbar Bhatti

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Abdul Jabbar Bhatti

ABSTRACT

The objectives of this study entitled "Curriculum audit: An analysis of curriculum alignment at secondary level in Punjab" were to (a) determine the alignment of Supported Curriculum with the Written curriculum, (b) determine alignment of Taught Curriculum with the Written Curriculum, and (c) find out the alignment of the Assessed Curriculum with the Written Curriculum. The study was delimited to public schools in Punjab, subject of Biology IX-X, and question papers for the academic session 2013-2014. Sample of the study consisted of (a) 400 schools (6.1%) (b) 436 teachers (5.2%) (c) six Biology IX & X question papers (100%) administered by three Boards of Intermediate and Secondary Education (d) two Textbooks of Biology-IX & Biology-X (100%), and (f) one National Curriculum for Biology (Grades IX-X) (100%). The sample size was taken in accordance with Gay, Mills, & Airasian (2009) suggestion as well as by using the online "The Survey System". Keeping in view the research questions and the nature of population, multi-stage sampling method was employed for the selection of required sample size. The data were gathered by using observation check list, Surveys of Enacted Curriculum protocol for teachers, and content analysis protocol for the Written Curriculum, textbooks and question papers. For determining the extent of alignment quantitatively, matrices of same order were developed, and a mathematical procedure of using cell by cell comparison of data of the two sets was employed. It was found that the textbooks Biology-IX and X were considerably aligned at coarse grain level (AI 0.72) and Biology-IX at fine grain level (AI 0.74) but Biology X was considerably misaligned (AI 0.68). Similarly, Question Papers administered by BISEs were considerably aligned (AI 0.77) at coarse grain level but significantly

misaligned (AI 0.54 & 0.52) at fine grain level. The alignment level between written and taught curricula was different for different clusters of teachers. The written curriculum and curriculum taught by teachers of cluster-4 were aligned significantly (AI 0.84) at coarse grain level and considerably (AI 0.72 & 0.76) at fine grain level. Moreover, the written curriculum and the curriculum taught by teachers of Cluster-1 were considerably aligned (AI 0.71) at coarse grain level but considerably misaligned (AI 0.65 & 0.66) at fine grain level. However, the written curriculum and curriculum taught by teachers of Cluster-2 were considerably misaligned at coarse grain level (AI 0.66) and fine grain level (AI 0.61). Similarly, the written curriculum and curriculum taught by teachers of cluster-3 were significantly misaligned at coarse grain level (AI 0.59) and fine grain level (AI 0.54). It was recommended that (a) the content of the textbooks may be reviewed to make it aligned with written curriculum, (b) table of specification in accordance with the written curriculum may be followed for developing the question papers, (c) content in the textbook and number of items in question papers relating to Remember subcategory be reduced and proper representation of all other categories be ensured. Moreover, qualified teachers having relevant academic and professional knowledge may be provided and written curriculum may be properly disseminated to all the teachers.

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LIST OF ABBREVIATIONS/ACRONYMS

AI: Alignment Index

A. V. Aids: Audio-Visual Aids

B. Ed.: Bachelor of Education

BISE: Board of Intermediate and Secondary Education

CMMF: Chief Minister's Monitoring Force

DSD: Directorate of Staff Development

GOP: Government of Pakistan

HSSC: Higher Secondary School Certificate

IBCC: Inter Board Committee of Chairmen

M.Ed.: Master of Education

MOE: Ministry of Education

QCC: Georgia Quality Core Curriculum

PEAS: Punjab Education Assessment System

PEC: Punjab Examination Commission

PESRP: Punjab Education Sector Reforms Programme

PTB: Punjab Textbook Board

RD: Ratio Difference

SED: School Education Department

SEC: Surveys of Enacted Curriculum

SLO: Students learning outcomes

SSC: Secondary School Certificate

STS: Science-Technology- Society

UNICEF: United Nations International Children's Emergency Fund

DEFINITIONS OF THE TERMS USED

Alignment, Considerable:	There is considerable alignment if the value of alignment index [AI] is between 0.70 and 0.80.
Alignment, Good:	There is good alignment if the value of alignment index [AI] is greater than 0.90.
Alignment, Significant:	There is significant alignment if the value of alignment index [AI] is between 0.80 and 0.90.
Classroom instruction:	All the activities of teacher or student that are taking place inside or outside a classroom under the guidance of the teacher.
Coarse Grain level:	In the national curriculum as well as the textbook, content has been divided into six sections; analysis on the level of these sections is coarse grain level analysis.
Curriculum Alignment	Degree of match or overlap among classroom instruction, assessment, resources and curriculum.
Curriculum Audit	An objective review of curriculum including its processes, products, and performance
Curriculum, assessed:	Curriculum that is being assessed by the examination boards, it is delimited to the question papers administered by BISEs.
Curriculum, taught:	Curriculum that is being taught in the classrooms as reported by the teachers.

Curriculum, written: The documented curriculum developed by Ministry of Education, Government of Pakistan in 2006 and adopted by Punjab School Education Department Lahore.

Curriculum, supported: Curriculum reflected by the resources –textbooks and the apparatus, chemicals, charts, and models mentioned in the written curriculum.

Examination: Written or oral assessment conducted by Examination Boards in Punjab.

Examination board: Any one of the Boards of Intermediate and Secondary Education in Punjab.

Examination paper: The written or oral papers prepared and administered by the examination boards.

Fine grain level: In the national curriculum as well as the textbook, content has been divided into topics; analysis on the basis of these topics is fine grain level analysis.

Misalignment, Considerable: There is considerable misalignment if the value of alignment index [AI] is between 0.60 and 0.70.

Misalignment, Critical: There is critical misalignment if the alignment index [AI] is less than 0.50.

Misalignment, Significant: There is significant misalignment if the value of alignment index [AI] is between 0.50 and 0.60.

School, High:	The school which has classes from Grade-I to Grade-X or from Grade-VI to Grade-X.
School, Higher Secondary:	The school which has classes from Grade-I to Grade-XII or from Grade-VI to Grade-XII.
Secondary classes:	The Grade-IX (9 year schooling) and the Grade-X (10 years schooling).
Secondary level	Secondary level consists of Grade-IX & Grade-X
Secondary school teacher:	The teacher appointed to teach secondary classes.
Textbook:	Textbook is the book used as a standard work for the study of a particular subject particularly at school e.g. Biology textbooks developed by the Punjab Textbook Board for a Biology for Grades IX & X.

CHAPTER 1

INTRODUCTION

Secondary Education plays a vital role in social and economic development of any country because it provides necessary base for higher education, services, and industry. However, Secondary Education in Pakistan is marked by "low skills, low productivity, and low expectations" (Khan, 2009, p. 603). Realistic and practicable educational policies coupled with sincere efforts to implement these policies can significantly overcome these problems. Conversely, in Pakistan gap between policy making and its implementation is widening. For example, curriculum is developed to be followed in instruction, provision of resources and assessment. However, in Pakistan curriculum is only used for the development of textbooks (GOP, 2009, p. 35). Moreover, level of achieving students learning outcomes [SLO] has become a major yardstick for determining the quality of education due to shift of trend in education from teacher-centered to student-centered. The SLO specified in the curriculum cannot be achieved unless instruction and assessment are not harmonized with the curriculum (Smith, 2012). Therefore, for improving the quality of Secondary Education in Pakistan, it is necessary that instruction, resources, and assessment must be aligned with the curriculum.

The Curriculum Audit is a scientific method to analyze the system of education for delivering effective learning and teaching. It scrutinizes intensively the policies, planning, organizational relationships, administrative functioning, curriculum design and delivery, equity, feedback use, budgeting, facilities, and many other factors that contribute to the optimization of the school system. It provides accurate, objective, and meaningfully useful information for those serious about making their school system better in terms of student achievement. The main concern of curriculum audit is to investigate if the education system has a properly managed instructional programme (curriculum) that is planned, executed, and assessed in accordance with appropriate standards (Curriculum Management Systems, 2013). It means, curriculum audit not only analyses the curriculum but also investigates how much this curriculum is being implemented in classrooms. So, curriculum alignment is an important part of curriculum audit.

In Pakistan, curriculum alignment has become a hotly debated issue among educational stakeholders in Pakistan after the approval of 18th constitutional amendment and subsequent transfer of Ministry of Education to the provinces. The cash award grants for teachers coupled with accountability of teachers on the basis of students' performance in the public examinations have added zest to this discussion. The incentives as well as accountability are based on the performance of students in the public examination (Government of the Punjab, School Education Department, 2011, p. 3). These incentives motivate the teachers to enhance their performances which result in increased students' achievements (Baker & Linn, 2002). The accountability programmes are seen as instruments for improving classroom instruction (Resnick, Rothman, Slattery, & Vranek, 2003).

However, many educationists have also expressed their reservations about teachers' accountability based on students' achievements (Elmore, 2003; Fullan, 2003). Before employing the value-added approach to education (using the students' achievements as criteria for assessment of teachers), it is essential that the public examinations be made valid and reliable. Similarly, the resources and facilities should be distributed adequately throughout the province. The system of educational accountability also demands an effective coordination among curriculum, instruction, and assessment—three major components of education (Elliott, Braden, & White, 2001; Webb, 2002). Fragmentation among these components is a major barrier to the implementation of accountability (Fullan, 2003).

Curriculum is basic and crucial indicator of quality education (The Center for Comprehensive School Reform and Improvement, 2009) because it is an all-inclusive plan to achieve national goals by linking the standards to be achieved with teaching, learning outcomes, and the assessment. It is a document that reflects confidence of educationists, community members, parents, teachers and students on the type of the knowledge, values, skills and attitudes to be transferred to the learners. It consists of everything that happens under the patronage of the school (Miller & Seller, 1985, p. 3) and it is the result of student-teacher interaction for attaining specific objectives (United Nations Children's Fund, 2000, p. 10). It is an all-inclusive entity of an educational institution comprising the learner, the teacher, instructional strategies, learning techniques, experiences, and learning outcomes (Chikumbu, & Makamur, 2000, p.8).

Among various types of curriculum, the following four types play key role in the provision of quality education:

1. The written curriculum or curriculum that is sanctioned and approved and represents society's needs and interests (Glatthron, Boschee, & Whitehead, 2006).

2. The supported curriculum which consist of all the resources (such as textbooks, teachers, teaching-learning A. V. Aids) to deliver the written curriculum (Hume & Coll, 2010).
3. The taught curriculum or classroom instruction delivered by the teachers to the students (Kuhn & Rundle-Thiesle, 2009).
4. The assessed curriculum or curriculum that is tested by teacher-made-tests or any other tests (Anderson, 2002).

Alignment among these different types of curricula ensures quality education.

Research shows that content of instruction has direct impact upon the students' academic achievement (Rowan, 1998; Walberg & Shanahan, 1983) as students' learning is highly associated with the content they are taught (Anderson, 2002, p. 255). Moreover, the teachers are crucial decision makers about the content and its mode of delivery to the students (Porter, 2002, p. 3). However, the teachers, while making decisions about the content of instruction, are influenced by numerous sources such as examinations (Floden, Porter, Schmidt, Freeman, & Schwille, 1981), the textbooks, and the curriculum. Classroom instruction must be aligned with the curriculum for achieving the intended learning outcomes. If a teacher does not adhere to the written curriculum, performance of his students in the public examination is likely to be below expectations. So, knowledge of the content of instruction as well as the written curriculum is essential for effective educational implementation.

The education system in Pakistan is semi-centralized. The curriculum was developed by the Federal Government and it is being implemented by the Provincial or Local Governments, the text books are developed by the Provincial Textbook Boards; while external examinations are conducted by the Boards of Intermediate and Secondary Education [BISEs] which are autonomous bodies. Diverse layers of curriculum interpretation have such negative bearings on the taught and learnt curricula as are contradictory to the written curriculum (Hume & Coll, 2010, p. 43). Moreover, resistance from the local community may also hinder the true implementation of the written curriculum (Apple, 2003). So, there may be a gap between what has been suggested in the written curriculum and what is being taught by the teacher.

In Pakistan, the public examinations encourage rote memorization and cramming (Rehman, 2004), and these examinations neither cover the major concepts of the content nor assess the creative skills of the students (Hina, 2008, pp. 96-97). The validity and credibility of public examinations in Pakistan have also been criticized in many studies (e.g. Shah, 1998). Ignoring the guidelines given in the curriculum while conducting the assessment may be the reason behind these discrepancies. It indicates a gap between the written curriculum and the assessed curriculum.

Educational resources play a vital role in the actualization of written curriculum. However, there is deficiency, misallocation, and underutilization of available resources in secondary schools of Punjab (Dahar & Faize, 2011). It shows a disparity between the supported curriculum and the written curriculum. Moreover, physical resources available in the public schools are less than those of private schools (Iqbal, 2005). Additionally, the textbooks are not developed in accordance with the guidelines given in the written curriculum (Jumani & Bhatti, 2014).

All of these studies point towards lack of congruence among curriculum, instruction, and assessment. The extent to which curriculum, instruction, and assessment are coordinated for facilitating learning is termed as curriculum alignment (Roach, Niebling & Kurz, 2008, p. 158). Curriculum alignment and development of methods to measure alignment have recently got significant importance (Porter, Smithson, Blank, & Zeidner, 2007, p.1). Therefore, the present study explored the extent of alignment of the instruction (taught curriculum), resources (supported curriculum), and the question papers (assessed curriculum) with curriculum (written curriculum).

1.1. Rationale of the Study

The written curriculum is an outcome of collective efforts of curriculum experts, educational administrators, teachers, and the community as all these stake holders are involved in the process of development of written curriculum. It symbolizes the consensus after negotiation among the experts (who suggest what should be taught), administrators (who ascertain the provision of resources) and the teachers (who inform what can be taught). Therefore, it is essential that the classroom instruction must be designed in such a way to achieve the learning outcomes identified in the written curriculum (Kuhn & Rundle-Thiesle, 2009, p. 352). However, this important document is not followed as needed (Goodson, 2010, p. 193). This common tendency of not following the written curriculum is so much alarming that Ellis (2004, p. 4) is tempted to theorize that "the developer proposes, but the teacher disposes". This necessitates serious efforts to ensure implementation of curriculum as envisaged, because research (Fisher, et al., 1978) shows that teachers may make unwise choices of content if reasonable steps are not taken to implement the written curriculum.

For harmonizing the taught curriculum with the written curriculum it is essential that the necessary resources must be provided. Appropriate teaching and learning materials are necessary for actualization of curriculum. Pakistan, being an overpopulated developing country, has always faced scarcity of resources for proper implementation of the curriculum. Moreover, inadequate use of available resources further deteriorates the situation.

To address these problems, efforts are necessary for ensuring the alignment of different types of curriculum. Conducting curriculum audit is estimating the degree of alignment of different types of curriculum. Throughout the developed world various agencies have conducted curriculum audit and found gaps between what is intended and what is actually being done. In Pakistan no effort to find out this gap between different types of curriculum is known to the researcher. This gap may exist as demonstrated by the following evidences.

1. *Secondary School Teachers knowledge of curriculum:* Basic professional qualification required to become a secondary school teacher is B. Ed. Degree which is actually a nine months pre-service teachers training programme. This duration is too little to allow a catholic comprehension of the field of curriculum. Moreover, these secondary school teachers get in-service promotion because of seniority in service and reach the administrative posts. On these grounds it is a real concern that the teachers as well as the school management may not have *au fait* knowledge of curriculum and the classroom instruction along with the assessment may not be aligned with the written curriculum.

2. *Researcher's Personal Experience:* The researcher himself has worked as secondary school teacher for about ten years (from 1997 to 2007). During this period, he had not even seen the document of written curriculum because he was provided neither curriculum nor the teacher guides. He knew written curriculum through the textbooks. The secondary school teachers with whom he used to work or he had

interactions with (while working in various secondary schools) also had never claimed that they had read the written curriculum. There were numerous reasons for this. Firstly, copy of curriculum document was not supplied to the school. Secondly, there was also lack of awareness about need of curriculum as the teachers never demanded it. Thirdly, the textbook was thought to be everything as the question papers for external assessment were set from the textbooks. So, its need was underestimated.

The factor *lack of awareness about need of curriculum* seemed to be strengthened by an another experience. During the last four years, while teaching to M.Ed. classes (post graduate programme after B.Ed.), the researcher used to ask the students if they had gone through the written curriculum of any subject. The researcher mostly got reply in the negative. All these experiences indicate that gap may exist among the written curriculum, the taught curriculum, and the assessed curriculum.

3. Findings of Studies: Bhatti and Jumani (2011, p.7) in a research found that the educational managers in Pakistan had inadequate knowledge of the educational policies and the curriculum. If the educational management lacks in proper understanding of the curriculum, they may not take appropriate measures to implement it. Jumani and Bhatti (2014) in a research entitled "Finding the gaps of the concepts between textbook content and curriculum of social studies at primary school level" concluded that there was disparity between the textbooks and the written curriculum and the textbooks were not developed according to the instructions given in the written curriculum. This gap may also be present among written and taught curriculum as well as written and assessed curriculum. Moreover, Faize (2011, p.216) also stressed on need of "consistency" between policy making and its execution.

Short duration of teachers training programmes, researcher's personal experience, possibility of inadequate awareness of secondary school teachers and the educational managers about the curriculum, and the studies suggest that the taught, supported and assessed curricula may not be congruent with the written curriculum. It necessitates investigation of the degree of alignment among different types of curriculum. Therefore, this study was undertaken to analyze the alignment of the taught, supported, and assessed curricula with the written curriculum at secondary level in Punjab.

1.2. Statement of the Problem

The written curriculum provides guidelines about the classroom instruction. It guides about the resources needed for implementation of curriculum. The instructions for textbook writing and students' assessment are also given in the written curriculum. So, classroom instruction, teaching-learning resources, textbooks, and assessment must be consistent with the written curriculum. The research problem was to analyse if taught, supported, and assessed curricula were aligned with the written curriculum at secondary level in Punjab. The focus was to find out level of congruence among the content of textbooks, the content taught in classroom, content assessed by the examination Boards and the content suggested by the written curriculum.

1.3. Objectives of the Study

The objectives of the study were to:

1. Determine the alignment of supported curriculum with the written curriculum.

2. Determine alignment of taught curriculum with the written curriculum.
3. Find out the alignment of the assessed curriculum with the written curriculum.

1.4. Research Questions

Three interrelated questions with sub-questions concerned with the alignment of written, supported, and assessed curricula were explored in this study. The questions focused on alignment between the content documented in the written curriculum and; the content presented in textbooks, the content taught by the teachers in classrooms, resources available at schools, and content in question papers administered by the Boards of Intermediate and Secondary Education [BISEs] (which are responsible for assessing and certifying the students at secondary and higher secondary levels in Punjab).

1. To what extent is the supported curriculum congruent with the written curriculum?

1.1 To what extent do the contents of the text books cover the students learning outcomes given in the written curriculum?

1.2 How much do materials mentioned in the written curriculum are available in schools?

2. How much is the taught curriculum aligned with the written curriculum?
3. To what degree are the question papers congruent with the written curriculum?

1.5. Significance of the Study

Studies on curriculum alignment are important for examining the effective implementation of the written curriculum and help the stakeholders in improving the situation (Hume & Coll, 2010, p. 45). The present study would also be helpful for all the educational stakeholders in implementing the written curriculum.

The primary focus of most of the research on curriculum has been to devise ways for effective teaching. These efforts facilitate teachers in making practical decisions for implementation of curriculum (Triche, 2002, p.33). The curriculum alignment studies can be utilized as a tool for teachers' professional development (Liu, Zhang, Liang, Fulmer, Kim, & Yuan, 2009, p. 778). The present study would be helpful for teachers in understanding the curriculum and modifying their instruction to make it aligned with the written curriculum. The study would also provide teachers diagnostic information about the teaching learning process to enable them adopt effective changes in teaching styles that are harmonious with curriculum and the assessment.

Davis-Becker and Buckendahl (2013, p. 23) contend that alignment studies are "a key source of validity evidence" for the analysis of educational examinations. Thus, this study would help in understanding the nature of examinations at secondary level in Punjab. It would also help the examiners responsible for assessing the students at secondary level in Pakistan in appreciating the gap between theory and practice. Moreover, it will facilitate them in conducting assessment of students according to the guidelines given in the written curriculum.

The study will also facilitate the curriculum developers in Pakistan by providing them information about what are their intentions and what are the ground realities about the implementation of the developed curriculum. The gaps found will provide them useful guidelines for curriculum change and developing the curriculum that is realistic and workable in the field. It will enable them to address the disagreement between the written and supported curricula, written and assessed curricula, and written and taught curricula.

It is hoped that the study will also guide the educational administrators in providing necessary resources for implementation of the written curriculum. It will also motivate them to make arrangements for maximum utilization of all the available resources.

The study will thoroughly analyze the textbooks in the light of the written curriculum; therefore, it would particularly be helpful for the textbook developers by showing them the gaps between what the curriculum demands from a textbook and what the textbook is conveying.

The aligned curriculum has the capability to enhance students' attainment in education (Roach, Niebling, & Kurz, 2008, pp. 158-159). The present study will ultimately benefit the students as it will suggest the measures for effective schooling by showing how to achieve coordination among curriculum, instruction, and evaluation.

1.6. Conceptual Framework

Schools can impart quality education to the learners through learning outcome based curriculum that is delivered through competent and effective teachers (United Nations Children's Fund, 2000, p. 2). So, written curriculum is the foundation of excellence in education. It is a proposed documented plan for guiding learning that is put into practice in the classroom in a learning environment (Glatthron, Boschee, & Whitehead, 2006, p. 5). Curriculum is planned and documented to be taught in the classrooms with available resources. Therefore, it is essential that the resources and the classroom teaching must be aligned with the written curriculum.

Various models of curriculum alignment have been developed by different curriculum specialists. These models provide a basic framework of curriculum alignment. English and Steffy (2001, p. 13) put forward curriculum alignment model as shown in Fig. 3. This model seeks to find degree of congruence among written, taught and assessed curricula. It evaluates the assessment in relation to the goals and objectives mentioned in the written curriculum. This model has been also employed by other educationists in their studies of relationship between different types of curriculum.

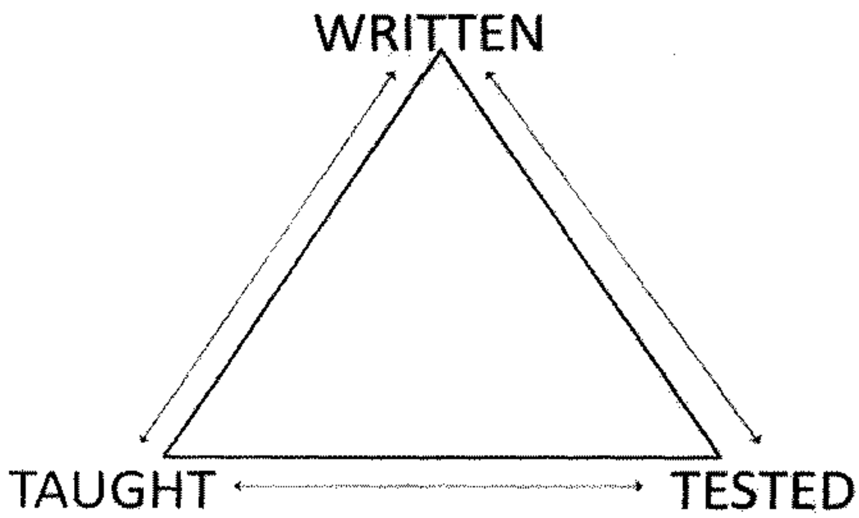

Figure 1.1. Curriculum alignment model (English & Steffy, 2001, p. 88).

The present study adopted the curriculum alignment model presented by English and Steffy (2001) with minor modification that is adding supported curriculum in the model and finding out the alignment of taught, tested and supported curricula with written curriculum. The modified model is shown in Fig. 1.2. This modification was considered appropriate to achieve objectives of the study.

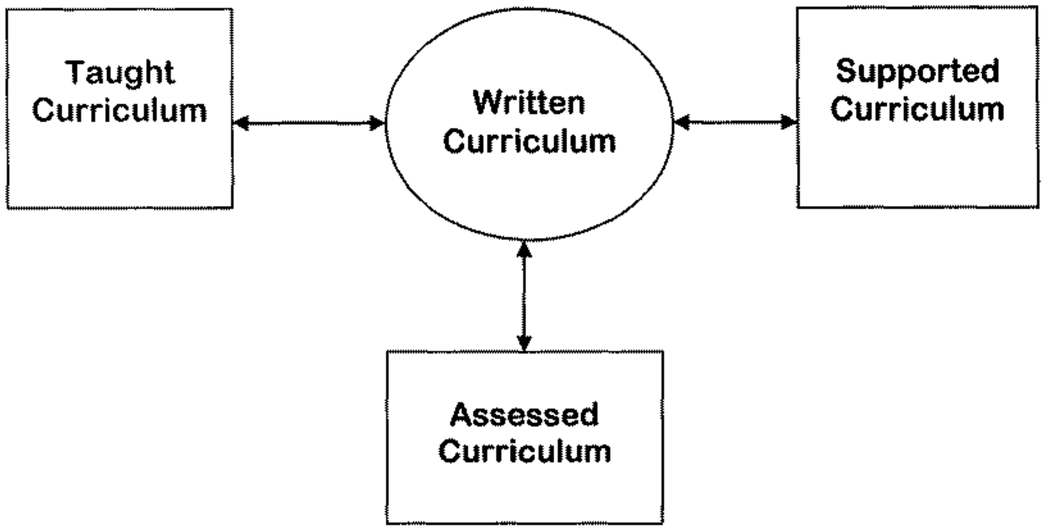

Figure 1.2. The modified model of curriculum alignment.

Several educationists, agencies, and organizations have devoted their rigorous efforts and succeeded in developing numerous detailed methods for evaluating the curriculum alignment. However, three models of curriculum alignment evaluation that is Webb's alignment model, the Surveys of Enacted Curriculum (SEC) model, and the Achieve model, are regarded the best choices for measuring alignment (Council of Chief State School Officers, 2005). Both Webb and Achieve models of curriculum alignment evaluation provide good statistical tools for comparing the alignment between the standards and the assessment. On the other hand Surveys of Enacted Curriculum (SEC) model is unique in the sense that it offers tools for quantitative comparison of the extent of alignment among curriculum (standards), classroom instruction, curricular materials (such as textbooks), and assessment. Moreover, it provides method to present the results visually in the form of topographical maps, thus, making the interpretation of data easy. As the present study aimed to seek alignment analysis of taught, supported, and assessed curricula with the written curriculum, so the SEC model of curriculum alignment analysis was more suited and this model was employed for collection as well as interpretation of data.

1.7. Delimitations of the Study

The delimitations of the study and the reasons are described in Table 1.1.

Table 1.1

Description of delimitations of the study

Sr. No.	Delimitation	Reasons
1	Public secondary/ higher secondary schools	Some of the private schools do not follow the curriculum of the Ministry of Education and most of the authorities of private schools hesitate to allow outsider to take any kind of data from their school.
2	Boys School	Social taboos were barrier for the researcher to collect data from the girls' school.
3	Subject of Biology	Owing to researcher's interest and experience in teaching the subject of Biology.
4	Three BISEs	As the data for the taught curriculum was gathered from four districts that fall under the jurisdiction of three BISEs, therefore, Biology IX & X question papers of these three BISEs were taken.
5	Question papers for the academic session 2013-2014	As the data about the taught curriculum was gathered during the session 2013-2014, therefore, the question papers were also taken for analysis for the same period.

1.8. Assumptions of the Study

It was assumed that the textbooks Biology-IX & Biology-X developed by the Punjab Textbook Board were taught at secondary level in all the public Secondary/Higher Secondary schools in Punjab.

1.9. Research Design and Methodology

Quantitative research approach is application of the natural science method of research for exploring the educational world (Scott & Morrison, 2007, p. 185). The purpose of the study was to examine relationship of different types of curriculum. Quantitative research method suits well for relationship studies (Creswell, 2009, p. 4). So, the objectives of the study were achieved by employing the quantitative research method.

1.9.1. Population

The population of the study included:

1. All the 6563 Secondary and Higher Secondary schools in Punjab as well as 8369 teachers teaching Biology to secondary classes in these schools
2. Biology-IX & X question papers administered by 8 BISEs in Punjab during session 2013-2014
3. Biology-IX & Biology-X textbooks
4. National Curriculum 2006 (Biology-IX & X)

1.9.2. Sample of the Study

The sample of the study consisted of (a) 400 (6.1%) schools, (b) 436 (5.2 %) teachers, (c) six (100%) Biology IX & X question papers administered by three Boards of Intermediate and Secondary Education, (d) two (100%) Textbooks of Biology-IX & Biology-X, and (f) one (100%) National Curriculum of Biology Grades IX-X.

1.9.3. Sampling Techniques and Justification of Sample Size

The sample size was taken in accordance with Gay, Mills, & Airasian (2009) suggestion as well as by using the online "The Survey System". Keeping in view the research questions and the nature of population, single sampling technique was not adequate, multi-stage sampling method was employed for the selection of required sample size. The detail of the sampling techniques employed for sample selection is given in Chapter 3.

1.9.4. Research Instruments

Research instruments employed for collecting data are given in Table 1.2.

Table 1.2

Description of research instruments

Sr. No.	Instrument	Data source
1	Observation check list	Schools
2	Surveys of enacted curriculum protocol	Teachers
3	Content analysis protocol	Question papers Textbooks Curriculum

1.9.5. Development of Research Instruments

Observation provides reliable data. So, to find out the available resources for implementation of the curriculum an observation check list was prepared. The data from the teachers were collected through Surveys of Enacted Curriculum [SEC] protocol which is a standardized instrument for collection of data about alignment of classroom instruction with written curriculum and is being used in more than 17 states of United States of America (Roach, Niebling, & Kurz, 2008, p. 163). The Surveys of Enacted Curriculum protocol was used with modification. It consists of two-dimensional matrix comprising of (a) level of coverage and (b) cognitive demand. The category cognitive demand has been further divided in to five subcategories which are (a) memorize (b) perform procedures (c) communicate understanding (d) solve non-routine problems and (e) conjecture/ generalize/prove. Owing to the distribution of Students Learning Outcomes (SLO) given in the written curriculum, these subcategories were replaced by four subcategories which were (a) Remember, (b) Understand, (c) Skills, and (d) STS connections.

Content analysis means to summarize and analyse messages scientifically (Neuendorf, 2002, p. 10). According to Rugg and Petre (2010, p. 152), by content analysis, one discovers "what is said in text, how it is said, and how often it is said?" A content analysis protocol developed by Porter (2002) was used for analyzing the written curriculum, the textbooks, and the question papers. This instrument was also modified in a manner similar to the surveys of enacted curriculum protocol for teachers.

1.9.6. Validity and Reliability

The validity and reliability of all the instruments were ensured by taking following steps:

(i) Seeking experts' opinion

(ii) Pilot-testing

(iii) Applying Davis-Becker and Buckendahl's model for evaluating the curriculum-alignment studies

(iv) Ensuring high inter-raters correlation

Further details are given in chapter 3.

1.9.7. Data Collection

For analyzing the content, subject relevant experts were needed. Therefore, two subject matter experts who (a) had good knowledge of the content and curriculum, (b) were familiar with the abilities and knowledge level of learners, and (c) possessed working experience were taken as panellists. These Panellists analysed the written curriculum, textbooks, and examination papers by using the content analysis protocol. For collecting data from schools and teachers, approval was got from the concerned authorities. The schools were visited to collect data on the observation checklist. During this process, the sampled teachers were trained and motivated to cooperate in the study. The data from the teachers were collected at the end of the academic year 2013-14.

1.9.8. Data Analysis

The data obtained through research instruments were organized. The data obtained through the Surveys of enacted curriculum protocol for teachers and content analysis protocol for written curriculum, textbooks, and the question papers were tabulated and percentages were calculated. For determining the extent of alignment quantitatively, matrices of same order were developed, and a mathematical procedure of using cell by cell comparison of data of two sets was applied. Following formula (given by Porter, 2002) was used for developing the alignment index.

$$\text{Alignment Index} = 1 - \frac{\Sigma\,|x-y|}{2}$$

Here, x stands for value in one matrix whereas y stands for cell value in other matrix. Microsoft Excel was used for the application of this formula. For determining the areas of alignment/misalignment, the results were shown in the form of graphs which are easier to understand because these place every element of the descriptions side by side.

The data obtained through the observation check list were analyzed by percentages and mean scores. The conclusions were drawn and the recommendations were made.

1.10. Chapter Overview

This introductory chapter has explained relevance and need of the study. The objectives of the study were to (a) determine the alignment of supported curriculum with the written curriculum, (b) determine alignment of taught curriculum with the written curriculum, and (c) find out the alignment of the assessed curriculum with the written curriculum. This chapter provided the glimpse of the study to achieve these objectives. After being acquainted with the problem, objectives, research questions and research design of study, it is necessary to have theoretical foundations and background knowledge of study. For this purpose review of related literature is presented in the next chapter (Chapter 2).

CHAPTER 2

LITERATURE REVIEW

This study aimed at investigating the alignment of supported, taught, and assessed curricula with the written curriculum at secondary level in Punjab. In this chapter review of related literature is presented. It consists of two main sections. The first section provides review of literature pertaining to curriculum, types of curriculum, and curriculum coordination. While, the second section gives an overview of agencies responsible for development and implementation of curriculum in the Punjab. It also provides a review of written curriculum for Biology for secondary classes in the Punjab.

2.1 Curriculum

Curriculum is essence of education. Education is transfer of knowledge, attitudes and skills from one generation to the next generation where as curriculum "reflects forms of knowledge, habits of thinking, and cultural practices that a society considers important enough to pass on to succeeding generations" (Triche, 2002, p. 1). Educationists have defined the term curriculum with such diversity that the term has become an abstruse and hard to pin down term (Psifidou, 2007, p. 17). Extensive range of definitions provoked writers like Huebner (1976, p. 156) and Vallence (1983, p. 159) to contend that curriculum cannot be taken as field of study or a field of curriculum have contributed to the establishment of assorted definitions of curriculum. There being no consensus over a single definition of education, same is the case with curriculum. A wide variety in its definitions does not point towards its ambiguity but towards its comprehensiveness and richness of its scope. Each definition communicates a particular aspect or characteristic of curriculum adding its depth and breadth. It may reflect what is taught at school, set of subjects, programme of studies, set of materials, set of objectives, course of studies, everything happening in school, annual plan of school, or experiences of the learners within or outside the school.

However, these definitions can be grouped into different categories. Ellis (2004, pp. 4-5) suggests that some definitions are prescriptive that suggest "how things ought to be" while others are descriptive which explain "how things are" in the schools. Educational philosopher like Dewey, Rugg, Tyler, and Triche give a prescriptive definitions of curriculum when they suggest that curriculum is:

- Revamping of child's experience to "the organized body of truth" (Dewey, 1902, p. 11)
- Preparation of learners for "meeting and controlling life situations" (Rugg, 1927, p. 8)
- Sum of "all the learning experiences planned and directed by the school" (Tyler, 1957, p. 79)
- Purposeful and it represents "society's past, present and future beliefs" (Triche, 2002, p. 1).

These definitions acknowledge the dominant role of institution or teacher who is influencing the learners. Here, the institution or teacher is responsible for transforming the learners' personality in such a way that it is accepted by the society. On the other hand, in the descriptive definitions, the educationists put the learners in focus and define things happening with respect to the learners. For example, Hopkins (1941) suggests that curriculum includes everything which the learner willingly receives and assimilates so that it shapes his future behaviour. Similarly, Cornbleth (1990) defines curriculum as the "interaction" of students with the teacher, knowledge and environment. In this way, Tanner and Tanner (1995, p. 189) also give a descriptive definition when they contend that curriculum is such change in knowledge and experience of learner that helps the learner in controlling incidents wisely.

Some educationists think that curriculum is only based on content as it is "a systematic group of courses or sequences of subjects" (Good, 1988, p. 157), others consider it to consist of "the formal and informal content and process by which learners gain knowledge and understanding, develop skills, and alter attitudes, appreciations, and values under the auspices of school" (Doll, 1996, p. 15). Some think it to be an "output of 'curriculum development system' and an input to 'instructional system'" (Johnson, 1967, p. 130), some others consider it to be a "plan for providing sets of learning opportunities for persons to be educated" (Saylor, Alexander & Lewis, 1981, p. 8), and some others suggest that curriculum includes "entire range of experiences, both directed and undirected, concerned with unfolding the abilities of the individual" (Bobbit, 1918, p. 43) or "all experiences children have under the guidance of teachers" (Caswell & Campbell, 1935, p. 66). All these definitions broaden the scope of curriculum. So, anyone who is interacting with the learner becomes part of the curriculum. In addition to teachers or the school administration, the companions, parents, and even cafeteria workers also become part of the curriculum.

2.2 Levels of Curriculum Development

McNeil (2006, pp. 89-91) noted that curriculum may be developed at four levels:

1. Societal
2. Institutional
3. Instructional
4. Personal

2.2.1. Societal level

At the societal level, curriculum is developed by the federal level agencies, boards of education, publishers, and curriculum reform committees. The curriculum developed at this level is mostly based on theoretical knowledge and is mostly reflection of the educational policy rather than field experience. However, school administrators, teachers, parents, and students are also consulted to make it more practical. It is prescriptive and general, giving less space for individuality or local needs. Here, the politicians, corporate leaders and organizations are more influential in shaping the curriculum. However, the curriculum is developed by the professional experts such as curriculum specialists, subject specialists and psychologists. It serves the egalitarian interests and brings uniformity throughout the country. For achieving the advantages of this type of curriculum, efforts are required for maximum alignment at state, district, school, and classroom level.

2.2.2. Institutional Level

Here, the curriculum is developed by the school administration and teachers. However, the students, parents as well as the local community may also be involved.

Curriculum at institutional level is more aligned to the institutional goals. The vocational and training schools mostly develop their own curriculum according to the nature of particular job or skill they are going to prepare students.

2.2.3. Instructional Level

The instructional level curriculum is developed by the classroom teacher. The teacher sets the learning outcomes keeping in view his actual experience of the learners. It is based on practical knowledge of the learners and the locality. However, it may lack the depth and breadth. The effective teachers develop the curriculum that is more aligned to national policy and standards.

2.2.4. Personal Level

Here, the learners are not passive recipient of something pored upon them but they are choosing and self-selecting individuals. They construct their own meanings from their classroom experiences. This curriculum is challenging, but flexible, innovative and learner-friendly. It allows the learners to grasp clearly the learning goals and progress purposefully through active learning. Nussbaum's (2000) concept of 'practical reason' and 'affiliation' is much important here. 'Practical' reason implies that the learners must contemplate critically upon the plan of their life and formulate their goals. 'Affiliation' means having ability to live effectively with others and showing exemplary social interactions. This is possible when the learners are empowered to make decisions about themselves. The *Magnet Schools* in America (which offer diverse options to the students in choice of individualized curriculum) are examples of institutions where personal curriculum decisions are made.

2.3 Types of Curriculum

The diversity in defining the curriculum also exists in describing its types. Different writers have used different terminology for categories of curriculum. However, it is interesting that many curriculum specialists have used different terminology for the same type of curriculum. These different types of curriculum are presented in Figure 2.1.

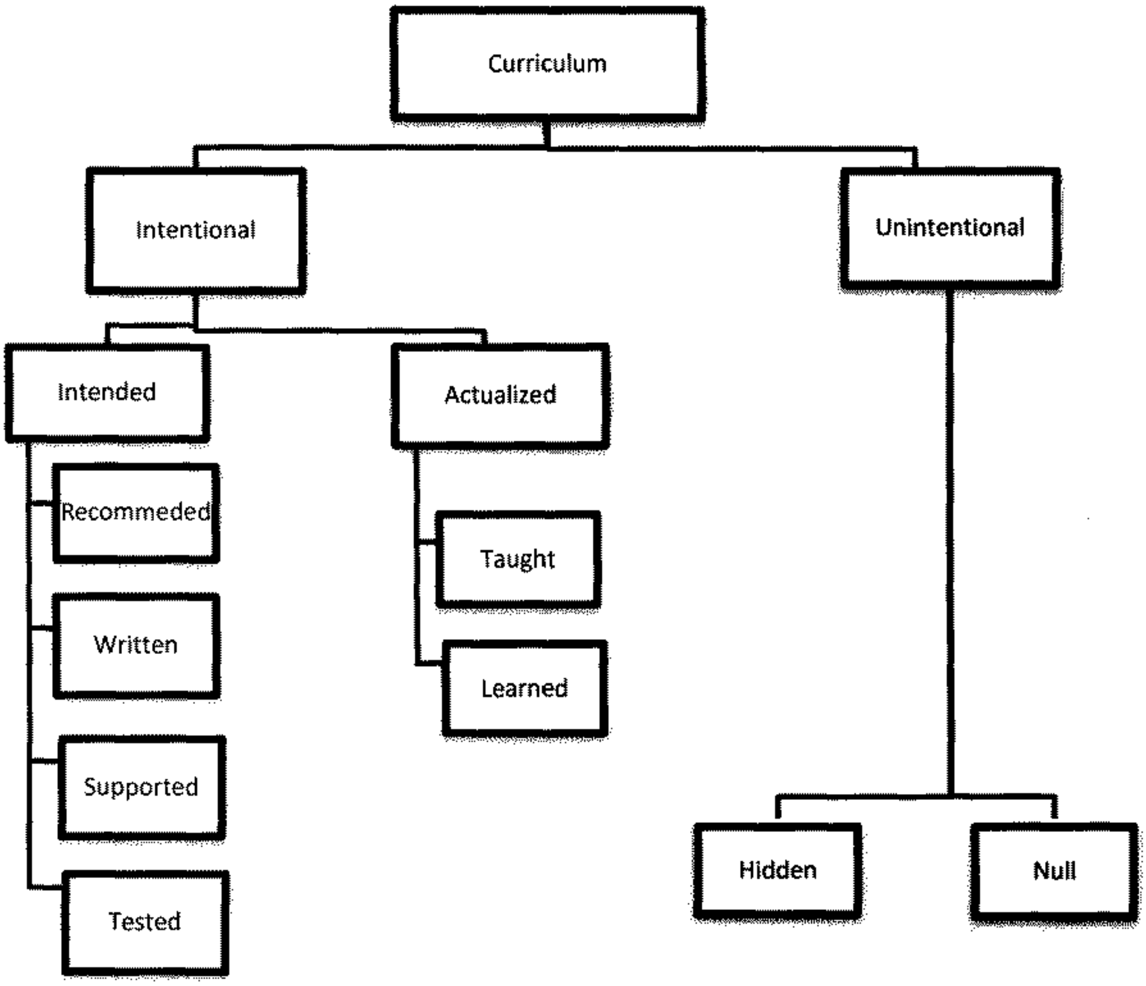

Figure 2.1. Types of curriculum

2.3.1. Intentional Curriculum

It is the curriculum that consists of "the set of learnings that the school system consciously intends" (Glatthron, Boschee & Whitehead, 2006, p. 6). There are following forms of intentional curriculum;

2.3.1.1 Recommended curriculum: It is also termed as ideological curriculum. It is the curriculum developed by the educational stake holders at national level. It is more general and usually consists of policy guidelines. It actually reflects the impact of "opinion shapers" such as:

- policy makers,
- educationists,
- scholars,
- professional associations,
- legislators

The recommended curriculum provides basic framework for instruction. It identifies the key learning areas, specifies the boundaries as well as the destinations. Thus, it guides a curriculum coordinator in formulating the academic standards to be achieved through different teaching-learning programmes. The National Education Policy guides formulation of curriculum for the education system in Pakistan.

2.3.1.2 Written curriculum: It is also called the enacted curriculum. It is curriculum that is sanctioned and approved. It represents society's needs and interests. The broad goals of the recommended curriculum are translated into specific learning outcomes. Glatthron, Boschee, and Whitehead (2006, p. 9) note that the written curriculum is specific as well as comprehensive and it indicates:

- Rationale of curriculum

- General goals to be realized
- Specific objectives to be achieved
- The sequence of objectives
- Kinds of learning activities

Written curriculum is authentic because it is product of visionary educators and has deep and life-lasting effect on the learners (Wolk, 2010). The written curriculum can be (a) generic or (b) site specific. The generic curriculum is usually developed at national level and is used in a variety of educational settings. On the other hand, site specific curriculum is developed for a particular site usually district.

The written curriculum is a practicable plan because it is result of compromise between the ideals recommended by experts and the real situations suggested by teachers, pupils and parents. It is essential for the teachers to have a clear understanding of the written curriculum and they must interpret the demands of curriculum as enacted in the document. Moreover, the professional development of teachers must be aligned with the written curriculum. National Curriculum is the written curriculum for the students of grades one to twelve in Pakistan.

2.3.1.3 Supported curriculum: All the available resources for delivering the curriculum are termed as the supported curriculum. The resources include both human (teachers) as well as physical (such as textbooks, workbooks, audio visual aids, teacher guides, grounds, buildings, library books and laboratory equipments). Supported curriculum affects development o f the written curriculum. It also plays vital role in implementing the curriculum and the quantity and nature of the learnt content (Glatthron, Boschee, & Whitehead, 2006, pp. 10-14).

Research indicates that teacher-student ratio (e.g. Achilles, Finn, Prout, & Bobbit, 2001; Danielson, 2002; Farber & Finn, 2000), the allocation of amount of time for a particular subject, and the quality of the textbooks (Allington, 2002) play a key role in students' learning.

2.3.1.4 Taught curriculum: Taught curriculum is the curriculum that is delivered by the teachers to the students. Some educationists also call it the operational curriculum. Teachers, being the chief implementer of curriculum, occupy a crucial role in curriculum decision making. Taking the students into consideration, they decide how to achieve the intended learning outcomes. They decide the distribution of time to particular activity/content. Even the external pressures like external exams cannot limit their freedom to exercise their own philosophy of instruction. Many educationists advocate that the teachers should be given more authority regarding curriculum, instruction and choice of instructional resources.

2.3.1.5 Learned curriculum: The changes that take place in the learners due to school experience are called the learned curriculum or experienced curriculum. It is the curriculum that a learner absorbs or makes sense of as a result of interactions with the teacher, class-fellows or the institution. It includes knowledge, attitudes and skills acquired by the student. Many educationists have defined curriculum as everything that learner experiences. This emphasizes dominance of the learner in the curriculum and excludes all that which has no effect on the learner. Thus, only the learned curriculum is the curriculum which has been transferred to the learner.

2.3.1.6. Tested or assessed curriculum: The curriculum that is reflected by the assessment or evaluation of the learners is called the assessed curriculum. It includes both formative and summative evaluation of learners conducted by teachers, schools, or external organizations. It involves all the tests (teacher-made, district or standardized) in all formats (such as portfolio, performance, production, demonstration, etc.). The assessed curriculum is significant as it enables the stakeholders to evaluate the impact of written and taught curriculum upon the learners. It determines the level of learned curriculum. Major issue regarding the assessed curriculum is that it should match the taught curriculum because research (e.g. Berliner, 1984; Turner, 2003) indicates that the mismatch has serious consequences.

2.3.2. Unintentional Curriculum

It is an unofficial and unrecognized curriculum. The personality of teacher, the manner teacher interacts with the students have effects upon the learners. This is unintentional curriculum. It is also called the informal curriculum. It may consist of following types.

2.3.2.1 Hidden curriculum: Gordon (1957) revealed that a part of learned curriculum was due to unintended result of activities or efforts of the institutions. This is called the hidden curriculum. It is unintentional because the teachers as well as other members of the educational institution convey messages that are not part of the officially approved curriculum. For example, the behaviour and attitude of the teachers may affect the students. Moreover, it may also be source of unintentional consequence of some act. For example, if a student (dis)likes some teacher's teaching strategy and begins (dis)liking the subject taught by that teacher, it is the hidden curriculum. Both positive and negative messages are included in the hidden curriculum. McNeil (2006, p.193) admits that hidden curriculum is "part of school ethos" and controls much of the students' learning, behaviour and social conduct.

2.3.2.2 Null Curriculum: It may also be termed as excluded curriculum as it is the 'not-taught' curriculum. A teacher may ignore some content or skill, deliberately or unknowingly. A teacher may consider some idea unimportant and ignore it. Similarly, teacher may avoid detailed description of some topic for the one or other reason, for example, evolution in Biology. It is called null curriculum. Sometimes, the learner fails to learn certain knowledge, skills or attitude owing to various reasons.

2.4 Curriculum Coordination

Curriculum is a framework to guide teaching as well as learning (European Centre for the Development of Vocational Training, 2010) as it outlines the breadth and order of teaching and learning content (United Nations Children's Fund, 2000, p. 5). Every member in the hierarchy of education system plays his role in executing curriculum because curriculum development and implementation requires inputs from all the stake holders. The duties of all the stake holders in the education system are related to some aspect of curriculum. For example, a teacher is implementing the curriculum. As a matter of fact, the whole education system revolves round the curriculum. Figure 2.2 defines the major educational stakeholders with reference to curriculum.

To achieve the goals and aims of educational system it is crucial that all the aspects of curriculum must be thoroughly coordinated. This is possible if all the members work as an organized team working for achievement of collective goals. The measures for bringing well coordinated curricula include:

- Curriculum audit
- Curriculum mapping
- Curriculum alignment

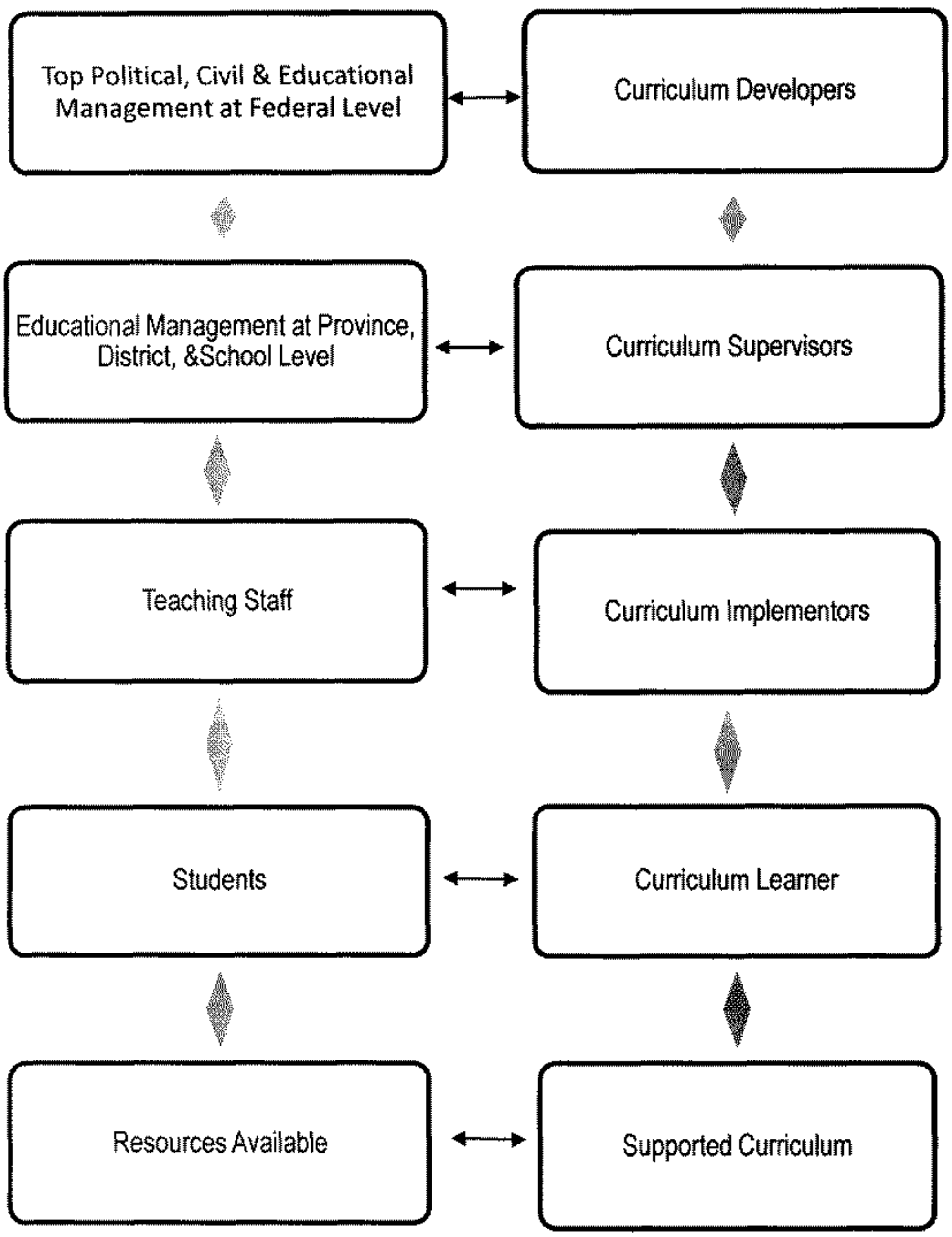

Figure 2.2. Educational stakeholders with reference to curriculum.

2.5. Curriculum Audit

Audit is defined as an objective review of something and curriculum audit can be defined as an evaluation of curriculum including its processes, products, and performance (North Dakota Department of Public Instruction, 2000, p.6). It determines "the degree to which written, taught and assessed curricula are aligned and the extent to which all the districts are organized to support development and delivery of curriculum" (Frase, 2000, p. ix). It scrutinizes critically as well as independently all the factors contributing towards effective functioning of the school system to see how much of the objectives of the school are being achieved.

Curriculum audit focuses on finding appropriate means to impart effective instruction for successful learning. Its course of action may be divided in to two categories which are diagnosis and recommendations. First of all, it evaluates the school system to diagnose its strengths and weaknesses by seeking answers of the following questions:

- Does the school's instructional programme (including planned, taught, and assessed curricula) correspond to set standards?
- To what extent is school system maintaining prescribed quality in its organization, management and operation?
- Are the available resources sufficient and being used to the optimal level?
- Does the educational system ensure equal success for all the students?

(Curriculum Management Systems, Inc, 2013)

On the basis of this evaluation, a concrete and all-inclusive course of action is recommended.

Curriculum audit is an effective instrument for quality control as it evaluates relationship among written, taught, and assessed curricula. It gives suggestions for improvement by pointing out the gaps present between various curriculum types. English (1988, xi), the pioneer in the field of curriculum audit, contends that curriculum audit is a powerful tool in achieving 'effectiveness and efficiency' of public education system. North Dakota Department of Public Instruction (2000) have listed the following advantages of curriculum audit:

- It provides useful data for prioritizing curricular needs.
- It identifies strengths and weaknesses.
- The process provides excellent experience in planning and conducting other evaluations.
- It conveys to both educators and the community the clear belief of an open evaluation process. (p. 3)

Elizondo (n.d.) contends that curriculum audit enables the management to make optimal use of human as well as financial resources to assure the taxpayers that their financial support is properly utilized.

There are different organizations for conducting curriculum audit. The curriculum audit points out the gaps among various types of curriculum and suggests practicable steps to implement the curriculum. For example, the first curriculum audit in Georgia (conducted by Phi Delta Kappa International division in 2000) found various disparities and as a result Georgia Quality Core Curriculum (QCC) underwent a massive revision (Phi Delta Kappa International, 2004, p. 20).

2.6 Curriculum Mapping

Curriculum mapping not only enriches teaching and learning process but also enhances effectiveness of curriculum implementation (Lam & Tsui, 2013, p. 99). Curriculum mapping ensures alignment of objectives of written, taught and learned curricula (English, 1984). Curriculum mapping is a term used to estimate how much of the intended objectives of a course or a program have been achieved by the learners (Jacobs, 2004; Uchiyama & Radin, 2009; Willett, 2008). Therefore, it is analysis of alignment between the written and learned curricula. Curriculum mapping ensures enhanced students' learning through deliberation and collaboration. It usually consists of following steps:

(a) A teacher individually develops his maps (also known as diary map) recording and reflecting what actually happened during his classroom instruction (during the last month).

(b) The teachers of a specific course gather, collect the maps prepared by the teachers individually, and review the map after discussion.

(c) The teachers of different courses gather to share their experience and further review the map.

(d) The teachers then identify weak as well as strong areas of instruction and the maps are revised.

(e) Final plan is developed after reaching consensus. This plan is implemented by all the teachers. This is a cyclic process and continues in search of the best. (Uchiyama & Radin, 2009)

The major advantages of curriculum mapping are:

- It fosters a trusted environment by developing mutually acceptable understanding (Hogan, 2000).
- It inculcates among teachers a sense of cooperation and teamwork (Tierney, 1999).
- It prepares teachers for conducting large scale studies (Lam & Tsui, 2013, p. 101).
- It helps the teacher in identification of coverage of learning outcomes.
- It helps in developing effective curriculum.

2.7 Curriculum Alignment

Alignment means the level of joint efforts from different elements of education system for achieving collective goal (Martone & Sireci, 2009, p. 24). Three major components of instruction are (a) planning, (b) delivery, and (c) evaluation. Curriculum is aligned when the delivery of the content (instruction) and the evaluation of the content (evaluation) are in accordance with the planned content (curriculum) (Leitzel & Vogler, 1994, p. 5). Similarly, English (2000, p. 63) has defined curriculum alignment as degree of 'match or overlap" among formal instruction, "content and format" of test and curriculum.

Curriculum alignment is a method of "educational quality control" where the "process of teaching and learning is predetermined, pre-paced, and pre-structured" (Rubin & Kazanjian, 2011, p. 94). The curriculum alignment requires teachers to teach "a standards-based curriculum with depth and complexity" and it will enable the learners to show high level performance in state exams (Schuenemann, Jones, & Brown, 2011, p. 64). Research shows that the underprivileged students demonstrate considerable academic improvement and increased intellectual abilities if the instruction is aligned with the curriculum (Blankstein, 2004; Evans, 2005; Lavin-Loucks, 2006) and curriculum is aligned with high-stake testing (English & Steffy, 2001; Hong & Youngs, 2008; Marzano, 2003). Moreover, the assessment should be harmonious not only with the classroom instruction but also with the curriculum. The assessment that is aligned with the curriculum evaluates the knowledge and skills as intended by the educational stake holders and expressed in the form of document called the written curriculum. Liu and Fulmer (2008, p. 382) propose following four key recommendations:

a) Content standards [written curriculum] must be treated as important policy document
b) Content standards should be debated openly in public and validated academically
c) The teachers should endeavor to increase alignment between taught curriculum and written curriculum
d) The standardized tests must be consistently aligned with the written curriculum.

However, achieving perfect alignment is neither easy nor common in practice. Karvonen, Wakeman and Flowers (2006) admit this fact and argue that it is because there are different agencies hiring set of experts for undertaking educational tasks at different levels such as developing written curriculum, making assessment, training teachers etc. This misalignment between written and assessed curricula puts teachers in conflicting situation of what to interpret of policy makers' demands and what to act upon in the classroom instruction (Fuhrman, 1993). Therefore, alignment of curriculum, assessment and the professional development of teachers have become a vital instrument in all the educational decision-making (Penuel, Fishman, Gallagher, Korbak, & Lopez-Prado, 2009).

2.7.1. Alignment of Taught Curriculum

It is essential for effective teaching that instruction is designed in such a way that it supports the learners to fulfil the desired course outcomes (Hall, 2002, p. 151). Similarly, Biggs (1999, p. 11) suggests that "teaching is effective when it supports those activities appropriate to understanding the curriculum objectives". It implies that a successful teacher creates a learning environment which is conducive to facilitate the learners in achieving the intended outcomes.

The written curriculum is developed to be taught in the classrooms. Basically, central issues of curriculum are "What we teach and how we teach" (Carson, 2004, p. 59). English (2000, p. 6) emphatically suggests that

> Once the curriculum content is adequately defined (a design issue), the teacher is obligated to teach it (a delivery issue) in some reasonably competent manner. Supervision involves an estimate of the adherence or fidelity of what is taught (not necessarily how it is taught) to what was supposed to be taught.

Liu and Fulmer (2008, p. 382) recommend that teachers should pay more attention to plan their classroom instruction in congruence with the state curriculum rather than the standardized tests. The teachers should continuously conduct alignment studies because research (e.g. Cohen, 1987, p. 18) indicates that root cause of low performance of some schools is not due to ineffective teaching but misaligned teaching.

Although research studies (e.g. Hamilton & Berends, 2006; Pedulla et al., 2003) indicate that teachers are making efforts to align their instruction with the written curriculum, there is still unconvincing alignment between the taught curriculum and the written curriculum (Polikoff, 2012; Porter, McMaken, Hwang, & Yang, 2011; Porter, Smithson, Blank, & Zeidner, 2007). There are different factors responsible for this misalignment. The major ones are:

- Lack of coherence in the policy system that is based on written curriculum (Polikoff, Porter, & Smithson, 2011)
- Teachers' lack of complete understanding of the written curriculum (Spillane, 2004; Hill, 2001)
- Non aligned policies at federal, state, district and school levels (Wong, Anagnostopoulos, Rutledge, & Edwards, 2003)
- Scarcity of available resources (Polikoff, 2013)

However, this lack of alignment is not equally distributed. Some teachers have succeeded in aligning their instruction to the written curriculum (Porter et al., 2007). In order to make instruction more aligned to written curriculum, Polikoff (2013, pp. 212-213) suggests that it is essential first to identify the factors and instructional practices which contribute towards more aligned taught curriculum and then make teachers (pre-service as well as in-service) aware of those factors and techniques. Here, Shulman's concept of curricular knowledge in his framework for teacher knowledge is very important. According to Shulman (1986, p. 10) curricular knowledge consists of teacher's grasp of all the programmes, instructional materials, and the features to use a curriculum in specific circumstances. One important factor behind less aligned curriculum is teachers' lack of understanding of (a) written curriculum as well as (b) the integral relationship between written and taught curricula (Huie, et al., p. IV).

2.7.2. Alignment of Learned Curriculum

The written curriculum specifies the students' learning outcomes which are defined as behaviours that the students demonstrate as a result of learning. Basic objective of classroom instruction is facilitating the students in achieving the learning outcomes. Therefore, it is important for the educators to find out satisfaction level of students with the teaching and how much students have learnt with respect to the intended [written] curriculum (Engelland, 2004). Kuhn and Rundle-Thiele (2009, p. 353) also assert that, for estimating alignment, it is necessary to know (a) if the students have achieved what was intended, (b) if the outcomes given in the written curriculum are relevant to students' interests, curiosities and abilities, and (c) if they would engage themselves more actively in the learning process. These conditions would make the learned curriculum more aligned to the written curriculum.

2.7.3. Alignment of Assessed Curriculum

Assessment measures the degree to which the objectives of the written curriculum have been achieved. Educationists like Contino (2012, p. 63) define curriculum alignment as the "match between standards and assessment". It ensures students' learning experiences to be consistent with the expected ones. If the assessment is not aligned with the curriculum, the students will not perform well in the exams. Consequently, the teachers would prefer not to implement the curriculum in the classroom (Li, Klahr, & Siler, 2006). Moreover, the misaligned assessment "cannot provide accurate data about students' or schools' progress relative to those expectations, and improvement actions based on such results are unlikely to further intended goals" (Webb, Herman, & Webb, 2006, pp. 1-2). Fuchs, Fuchs, and Hamlett (2007, p. 553) assert that the assessment aligned with the curriculum has at least three major positive features:

a) It has specified procedure for measuring specified behaviors

b) It has constant difficulty level of tests

c) It covers the whole curriculum

In this era of accountability, the teachers usually teach the content that is assessed. It enables the learners to perform well in the tests and get good grades. Therefore, if the assessed curriculum is aligned with the written curriculum, it would certainly increase the alignment of taught curriculum with the written curriculum. Polikoff (2012) also endorses this when he claims that the instructional alignment "should increase more when the standards and assessments are themselves well aligned and mutually reinforcing" (p. 343). On the other hand, misaligned assessed curriculum has several shortcomings. According to Porter, Polikoff, Barghaus, and Yang (2013, p. 416), major draw backs of misaligned assessed curriculum are:

- It conveys "confusing messages" to teachers about the content to be taught.
- It depreciates the content in the standards.
- It cannot give feedback to the teachers about their instructional efforts to help students in understanding the intended content.

Therefore, a well aligned assessed curriculum is vital for the implementation of educational policy (Porter, Polikoff, Barghaus, & Yang, 2013, p. 415).

2.7.4. Alignment of Supported Curriculum

All the educational stakeholders including policy makers, researchers and practitioners admit that standards, instruction and assessment must be aligned for achieving improved quality education (Olson, 2003). However, Li, Klahr, and Siler (2006) contend that it is not possible to achieve such alignment unless available resources for implementing the curriculum are adequate. On the other hand, there are also educationists (e.g. Allington, 2002) who think that the teachers must develop their own instructional resources and do not pay much heed to the prescribed instructional materials. In spite of these conflicting views, resources aligned to curriculum are essential for a "coherent science program" and effective instruction (Kesidou & Roseman, 2002, pp. 522-524). Among the curricular resources, textbooks are crucial. Therefore, the teachers as well as the students use textbooks extensively in the teaching learning process at school. Moreover, gaining success in the examinations is perceived as important criteria of assessing performance of schools. But, mostly the examinations in the developing countries are content centred as the test items cover the content given in the textbook (Çepni & Karab, 2011, p. 3226). In spite of widespread use of and dependence on the textbooks, the textbooks are not satisfactorily aligned with the standards (American Association for the Advancement of Science, 2005; Edvantia, 2005).

2.8. Factors Affecting the Curriculum Alignment

Curriculum development and implementation is a complex and all-inclusive process and it "involves complex concepts and ideologies" (Hok-chun, 2002, p. 56). Its all-encompassing nature is evident from the sources of curriculum (Figure 2.3). Therefore, a lot of factors affect curriculum alignment. However, the major factors affecting the curriculum alignment are: (a) Rationalized standards (b) Political support (c) Educational management (d) Teachers (e) Teachers' pre-service education (f) Available instructional resources (g) Accountability system

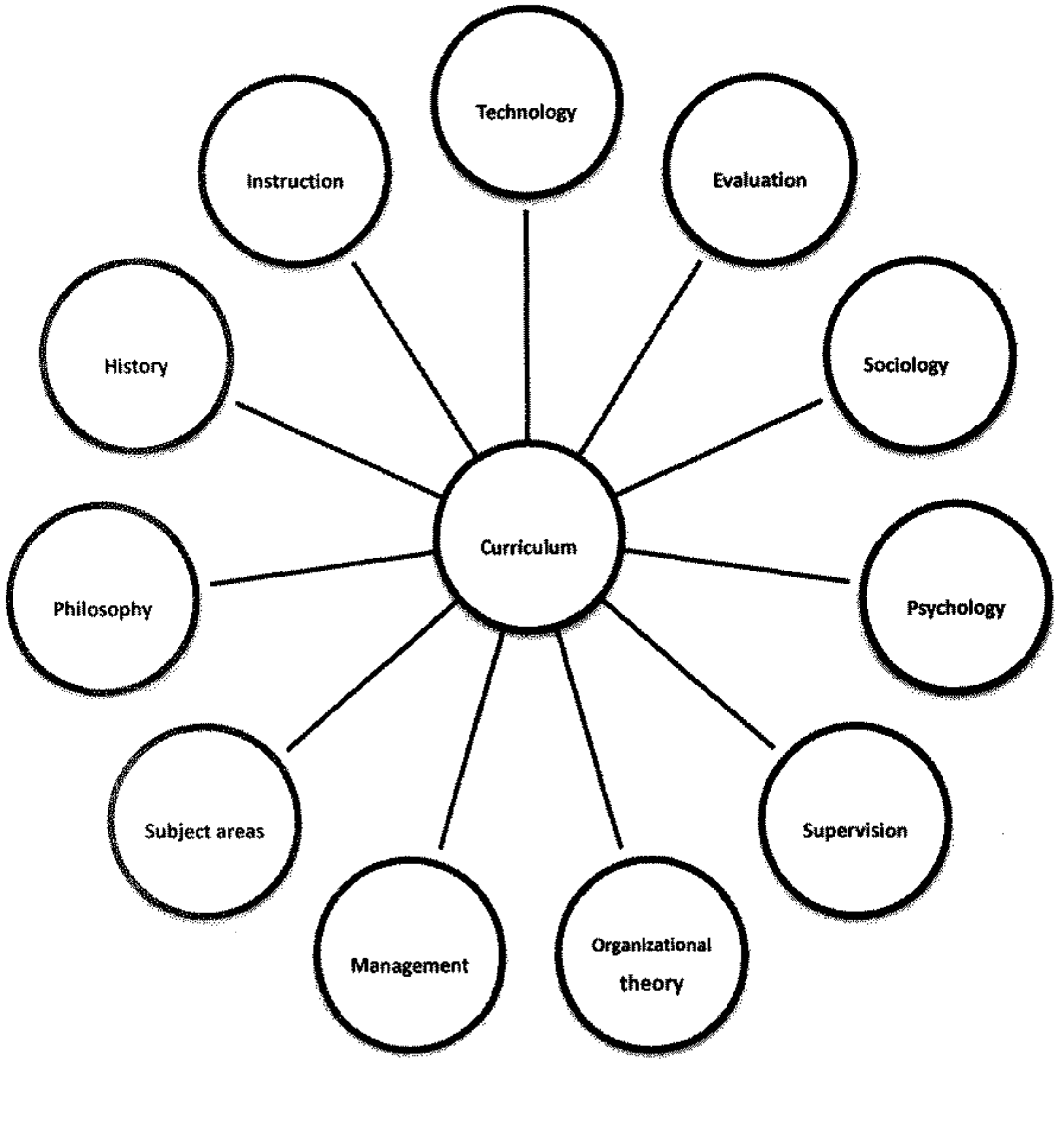

Figure 2.3. Sources of curriculum. Source: Oliva's (2001, p. 13)

2.8.1. Rationalized Standards

Implementation of a plan owes much to appropriate and realistic nature of plan. Similarly, curriculum alignment is feasible if the standards/learning outcomes stated in the written standards are achievable within the available resources. Therefore, the first important factor that affects the curriculum alignment is setting of rationalized standards. Rationalized means the intended content as well as skills are attainable keeping in view the resources such as teachers, textbooks, time, and instructional aids. Moreover, realization of the complex nature of teaching learning process is also crucial as most of efforts directed towards achieving increased alignment fail due to complex nature of educational setting (Honig, 2006). Here, the concept of "constructive alignment propounded by Biggs (2003) is pertinent. Constructive alignment means curriculum is developed in such a way that it facilitates the learners to achieve the intended outcomes. Kuhn and Rundle-Thiele (2009, p. 352) advocate that students' learning outcomes should be established after considering the "multiple viewpoints" that is taking into account all the stakeholders such as educators, learners, parents and society.

2.8.2. Political Support

Provision of education is legal responsibility of the state and it is the Government that enacts various policies/rules about the education system. Moreover, no policy can succeed unless political powers are determined to implement it. So, the Government' role in implementing the alignment of curriculum is crucial. The Government can formulate such policies to ensure curriculum alignment at all levels. It can also assist to achieve alignment by:

- Allocating necessary resources for the implementation of curriculum
- Authorizing the use of curriculum materials that are aligned with the written curriculum
- Organizing professional development training

2.8.3. Educational Management

Educational management from the school to national level plays a key role in setting the priorities as well as facilitating and guiding the teachers towards achieving the goals. For example, a school head can facilitate the teachers in aligning their instruction by (a) coordinating the efforts of teachers, (b) planning time distribution in such a way that every teacher gets sufficient time to implement the curriculum, (c) providing opportunities of professional development, especially in understanding the written curriculum, (d) organizing opportunities of sharing knowledge and expertise (Kruse, 2001) e.g. curriculum mapping activities, and (e) managing sufficient availability of resources. Moreover, the encouragement provided by the educational management to the teachers has great potential to motivate teachers for taking daring decisions for the implementation of curriculum (Scribner, Sawyer, Watson, & Myers, 2007).

2.8.4. Teachers

It is the teacher who plays a decisive role in the choice of content and instructional resources (Cross, 2009; Philipp, 2007; Torff 2005; Wilson & Cooney 2002). It is the teacher who implements the curriculum. So, teacher's understanding of the curriculum has direct bearing on the alignment. If teacher's choice of content, instructional strategies, use of resources, distribution of time and assessment correspond to the stated standards, the students will certainly achieve the specified learning outcomes. Consequently, there would be increased curriculum alignment.

McNeil (2006, pp.227-228), with reference to curriculum decision-making, categorises teachers into three levels (Table 2.1).

Table 2.1

Category of teachers with reference to curriculum decision-making

Decision	Level 1	Level 2	Level 3
Concept to be taught	Content from state and district	Content adopted to classroom context	Teacher and student social analysis and teacher's expertise in subject matter, knowledge of "big ideas"
Materials and activities	Textbooks, workbooks, recitations, direct instruction	Textbooks, supplementary materials, teacher- directed learning opportunities- projects, units, student discussion and small group participation	Multiple primary and secondary sources, data collection and analysis, investigations in real world, peer assisted learning, student led inquiry coupled with whole class review
Evaluation	Observations, embedded assessments, end-of-chapter tests, feedback-scores and grades	Benchmark measures, unit and performance tests, portfolios of student works, final exam, feedback-scores matched to rubrics and criteria, suggestions for improvement, grades for course	Exhibitions, poster sessions, published reports, self-assessments with peer reviews using agreed-on criteria, suggestions for improvement
Criteria and next step	Content standards, textbook	Sequenced performance standards, benchmarks	Student select what they want to do and analyze what knowledge would be necessary

Source: McNeil (2006, p. 228)

The teachers of level 1 impart instruction that is more aligned to the written curriculum. However, the teachers of this level lack freedom and follow the state curriculum along with school policies. The teachers belonging to level 2 are a bit self-determining and adopt the state standards to the classroom context. On the other hand, level 3 teachers are sufficiently independent and devise their own curriculum.

2.8.5. Teachers' Pre-service Education

Teachers' instructional activities depend upon the pre-service education they received (Coburn, 2004). This pre-service training inculcates the attitudes and skills in teachers that they will demonstrate in the classrooms. Therefore, the pre-service training can develop in teachers the ways and means to achieve the intended outcomes. Teachers' understanding and interpretation of the standards play an important role in the classroom instruction (Penuel, et al, 2009, p. 660). Moreover, it can induce an urge among the teachers to strive for curriculum alignment. So, teacher's knowledge of curriculum coupled with his/her urge to implement the curriculum in letter and spirit would enable him/her to actualize the written curriculum. Accordingly, the curriculum alignment will boost up.

2.8.6. Available Instructional Resources

Instructional materials play vital role in realization of educational reforms (Rowan, 2002). It is irrational to set the learning outcomes unless resources to achieve them are ensured. Curriculum alignment is possible if the available resources meet the curriculum requirements. The resources include both human and physical ones. Employing competent teachers is a key step towards implementation of curriculum. Moreover, physical resources such as textbooks, teachers' guides, proper buildings, audio visual, and other instructional materials which match the demand are essential in making the curriculum more aligned. Generally, sufficient resources are not provided to meet the demand of the curriculum. Therefore, Allington (2002, pp. 18-19) contends that for effective teaching it is essential that the teachers "must reject the state and district curriculum frameworks and create their own curriculum packages, often spending their own funds to do so" as mostly the resources given by the states cannot support the learners in grasping the content.

2.8.7. Accountability System

Accountability may influence teachers in choice of instructional content, strategies, and materials. A comprehensive accountability can be helpful in achieving the curriculum alignment. Accountability can increase students' achievement by persuading teachers to limit the gap between the intended, taught and assessed curricula.

2.9. Curriculum Alignment Models

Various models of curriculum alignment have been proposed by different educationists. These models are endeavours to see the need of congruence among different types of curriculum.

2.9.1. F. W. English's Curriculum Alignment Model

English (2000, pp. 63-91) sought to find linkage among the written, taught and assessed curricula. English (ibid) stresses that curriculum alignment is a method of quality control. His model of alignment consists of two important concepts i.e. *front loading and back loading.* Front loading means teaching according to written curriculum and developing tests in accordance with that curriculum. On the other hand, back loading refers to development of curriculum that matches tests. Here taught curriculum is also derived from the tests.

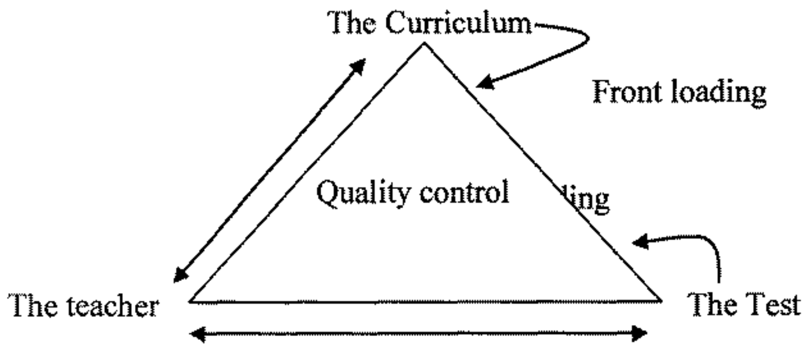

Figure 2.4. Curriculum Alignment Model of English (English, 2000, p. 64).

2.9.2. Leitzel and Vogler's Curriculum Alignment Model

Leitzel and Vogler (1994) contend that alignment occurs when delivery of content (taught curriculum) and analysis of learnt curriculum (assessed curriculum) are congruent with the planned content (written curriculum). Their model of curriculum alignment consists of three important steps which are (a) Planning to Delivery (PD) (b) Delivery to Evaluation (DE) (c) Planning to Evaluation (PE).

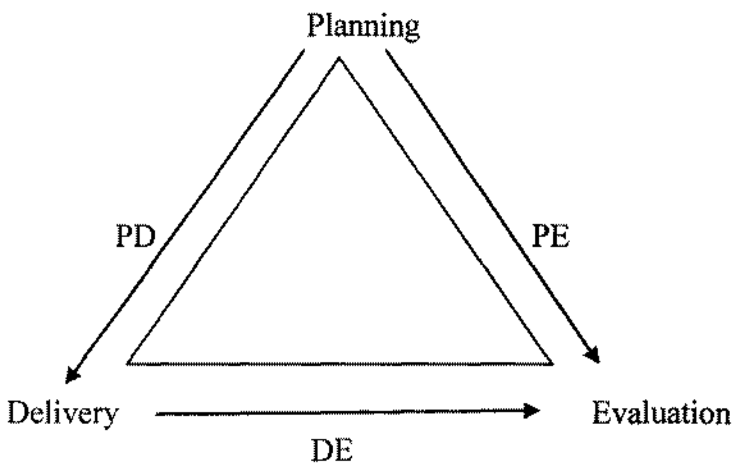

Figure.2.5. Curriculum Alignment Model of Leitzel and Vogler (Leitzel & Vogler, 1994, p. 2)

Leitzel and Vogler contend that unity of planning, delivery and evaluation is essential for achieving alignment. This unity calls for integration of planned, taught, and tested content. However, it is usual practice in the traditional instruction to ignore planned and tested content.

2.9.3. Anderson's Model of Curriculum Alignment

Anderson (2002, p. 255) suggests that objectives, instruction, supporting materials and assessment are the primary component of curriculum and asserts that relationship among these components is important. This relationship is illustrated in Figure 2.6. Where relationsip between curriculum and the assessment is denoted by A that refers to "content validity"- the degree to which tests measure the curricular objectives. B refers to "content coverage"- level of coverage of curricular objectives in classroom teaching. Whereas, relationship C refers to "opportunity to learn" which means if the teacher is teaching what is being tested.

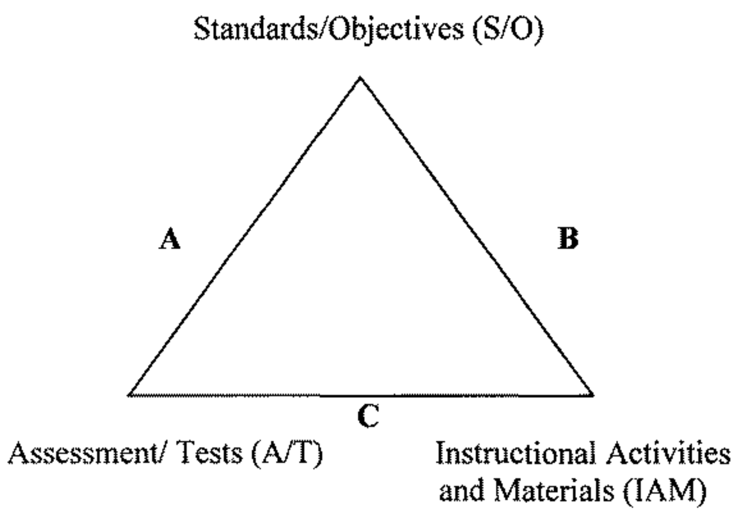

Figure 2.6. Anderson's Model of Curriculum Alignment (Anderson, 2002, p. 256)

2.9.4. Comparison of Curriculum Alignment Models

There are significant differences among the three models of curriculum alignment. These differences are given in Table 2.2.

Table 2.2

Differences among English's, Leitzel &Vogler's and Anderson's Curriculum alignment Models

Area	F. W. English's Model	Leitzel & Vogler's Model	Anderson's Model
Introduction	It was primarily developed for use in secondary schools management for curriculum audit.	It was developed after English's earlier model of curriculum alignment for alignment at college level.	It was developed to emphasize standards/ objectives for the content in tests and instruction.
Focus	Design of assessment is essential for achieving alignment.	Proper planning is essential for achieving alignment.	Achievable Standards/ Objectives are most important for achieving alignment.
Methods of achieving alignment	Alignment can be achieved by front loading (developing tests according to written curriculum) or back loading (developing curriculum that matches tests).	Unity of planning, delivery and evaluation is essential for achieving alignment.	Alignment can be achieved through (a) content validity and (b) content coverage.
Major factor of misalignment	Lack of linkage between instruction and tests as well as between tests and curriculum is cause of misalignment.	Misaligned assessment is main cause of misalignment	Improper content is main cause of misalignment
Components of alignment	This model discusses alignment among curriculum, tests and instruction.	This model discusses alignment among curriculum, instruction, and classroom and external tests.	This model includes the instructional materials in addition to curriculum, tests and instruction.

However, there are also many aspects which are common to these three models of curriculum alignment. Similarities among three models of curriculum alignment are given in Table 2.3.

Table 2.3

Similarities among English's, Leitzel &Vogler's and Anderson's Curriculum alignment Models

Relation ship	All of these three models seek relationship basically between the written, taught and assessed curricula
Main Focus	The written curriculum is main focus of all of these three models because these suggest alignment of taught and assessed curricula with the written curriculum.
Alignment Triangle	All of these three models have given alignment triangle to represent curriculum alignment graphically.

2.10. Models of Curriculum Alignment Measurement

2.10.1. Webb's Alignment Model

Webb's alignment model gives quantitative measure of alignment between the standards (written curriculum) and the assessed curriculum. It has been used for measuring alignment between the standards and assessment for various subjects in more than 20 states of United States of America. Roach, Elliott, and Webb (2005) contend that it is the only alignment measuring method that has been also used for the evaluation of students with disabilities. However, other alignment measurement models such as SEC have also been successfully employed for alignment measurement for students with disabilities (e.g. Kurz, Elliott, Wehby, & Smithson, 2010). Webb's model measures alignment on the basis of following four criteria:

(a) Categorical concurrence [representation]

(b) Depth of Knowledge consistency [depth]

(c) Range-of-knowledge correspondence [breadth]

(d) Balance of representation.

2.10.1.1. Categorical Concurrence: Content is of much importance, particularly in the science subjects. Categorical concurrence measures congruence between the standards and the assessment in content area. It measures how much of the state content standards is covered by the assessment. "The criterion of categorical concurrence between standards and assessment is met if the same or comparable categories of content appear in both documents" (Webb, Horton, & O'Neal, 2002, p. 5).

2.10.1.2. Depth-of-Knowledge Consistency: Measuring only the degree of match at content level is not enough. To have good alignment, it is also necessary that complexity of content coverage, with respect to cognitive demand, by the standards and the assessment must be same. The depth-of-knowledge category indicates "if what is elicited from students on the assessment is as demanding cognitively as what students are expected to know and do as stated in the standards" (Webb, Horton, & O'Neal, 2002, p. 6). *Consistency* is achieved if at least 50% items in both of the documents cover the content with same cognitive level.

2.10.1.3. Range-of-Knowledge Correspondence: This category measures congruence with reference to the breadth of knowledge and skills. It measures to what extent the assessment covers the knowledge and skills as demanded by the standards. This is done by considering the number of objectives addressed by the assessment items. The acceptable alignment level for this category is that assessment must include at least one item from 50% of objectives given for a standard. It gives equal emphasis to every objectives of every standard.

2.10.1.4. Balance of Representation: This category indicates the level of emphasis on an objective of standard by the assessment. It is an indication of comparative emphasis on one objective. It shows dispersal of assessment items. It can be calculated by computing the difference in proportion of objectives and the proportion of items in the assessment related to that objective.

For employing the Web's method reviewers (curriculum experts and educators) rate the items in the standards as well as assessment. Firstly, these reviewers are trained. Then they analyse the standards as well as the assessment and rate every item in the said documents on the categories given above. The level of consensus among the reviewers is very crucial as it may change the alignment results. Recognizing lack of consensus among the reviewers as problem, Webb, Herman, and Webb (2006, pp. 23-25), contend that this may be due to lack of training of the reviewers or ambiguity of objectives and standards.

2.10.2. The Achieve Model

The Achieve Model measures curriculum alignment quantitatively as well as qualitatively. Three or more reviewers analyse the standards and assessment and make low level as well as high level inferences. The reviewers may include curriculum specialists, content experts, and the teachers. These reviewers examine the standards and assessment on the following categories:

(a) *Content centrality*: Correspondence in the quality of content between the individual test item and correlated standard.

(b) *Performance centrality*: Degree of match with reference to cognitive demand.

(c) *Challenge*: Difficulty level of the items.

(d) *Balance*: How much the test represents the standards?

(e) *Range*: Level of coverage of standards by the test.

First of all the individual test items are examined on criteria given in Table 2.4.

Table 2.4

Quantitative categories of Achieve Model

Category	**Range of category**	**Description of subcategory**
Content Centrality	Clearly consistent	Item assesses the exact content stated in the standard
	Not specific enough	Standard is broad and cannot be confidently judged by item
	Somewhat consistent	Item samples only part of a standard
	Inconsistent	Item only marginally assesses what is prescribed by the standard
Performance Centrality	Clearly consistent	Same type and number of cognitive tasks
	Standard/objective too broad	Somewhat consistent
	Not specific enough	Item samples only part of the cognitive demands expressed in the standard/objective
	Inconsistent	Cognitive demands of test item and standard/objective do not match
Challenge	Items difficulty level appropriate or inappropriate	

Then the reviewers analyse the whole test on the criteria given in Table 2.5.

Here the reviewers generally make qualitative judgments.

Table 2.5

Qualitative categories of Achieve Model

Category	Description
Balance	Overall correspondence between standards and tests with reference to content as well as skills (ranging from good to poor)
Range	Overall coverage of objectives/standards assessed by the test.
Challenge	Overall difficulty level of test

2.10.3. Surveys of Enacted Curriculum [SEC] Model

Surveys of enacted curriculum model [SEC] also known as Porter's alignment model has been developed by Porter and his colleagues. The SEC has become a popular and powerful tool for evaluating standards, instruction and assessed curriculum (Woolard, 2007). Roach, Niebling and Kurz (2008) assert that this model essentially has following three features:

> (a) A common language framework for examining the content,
> (b) A single alignment statistic, and
> (c) Graphical output. (p. 164)

2.10.3.1. Common Language Framework: Content of written curriculum is of vital importance as the taught content directly influences students' learning (Porter, 2006; 2002). So, the alignment measurement models develop tools for determining the content of various curricula (written, supported, taught, and assessed). Therefore, it is essential that these tools must employ a uniform language that may describe all the content being evaluated for alignment. This language must be comprehensive as well as common enough to be used across studies and purposes (Porter, 2006). Developing "a common language to describe curriculum, instruction and assessment" is one of the chief characteristics of Porter's alignment model (Liu & Fulmer, 2008, p. 375). Moreover, language used by Porter's alignment model is "systematic and detailed" and can be applied to several curricular materials (Porter & Smithson, 2002).

The language employed by SEC model consists of two-dimensional grid which in turn is comprised of topics (in rows) and 'expectation for student performance' (in columns). Topics may be grouped into logical grouping of 'content area'. The content may be described at various levels known as grain size. The grain size decides the number of cells in the grid. The coarse grain level is description at broad level while the fine grain level is more detailed and presents data at the topic level.

The 'expectation for student performance' is the level of cognitive demand which the student is expected to achieve. This dimension is categorised into five descriptors that may vary according to the subject. For example, in science these are as under:

1) Memorize facts, definitions, formulas,
2) Perform procedures, conduct investigations,
3) Communicate understanding of science concepts,
4) Analyze information, and
5) Apply Concepts/Make connections. (Porter & Smithson, 2002, p.1)

Every topic is analysed using two scales of level of coverage and category of cognitive demand. The level of coverage consists of the time required or devoted to a topic and the category of cognitive demand is the relative emphasis on every 'student expectation'. Each scale usually has four points as given in Table 2.6.

Table 2.6

Description of level of coverage and cognitive demand

Level of Coverage	**(a)** *None/not covered*	**(b)** *slight coverage* (less than one class/lesson)	**(c)** *moderate coverage* (one to five classes/lessons)	**(d)** *sustained coverage* (more than five classes/lessons)
Cognitive Demand	**(a)** *No emphasis*	**(b)** *slight emphasis* (less than 25% of time spent on this topic)	(c) *moderate emphasis* (accounts for 25%–33% of time spent on this topic)	**(d)** *sustained emphasis accounts for* more than 33% of time spent on this topic)

(Porter, 2002, p. 4)

The specimen content analysis protocol is shown in Table 2.7. A trained panel of experts, using this content analysis, protocol accurately code the standards as well as the assessment. For measurement of content of instruction, this content analysis protocol is sent to teachers who report about the content of the instruction in their classes.

Table 2.7

SEC Content Analysis Protocol

Level of Coverage	Topic	Cognitive Demand				
Time		Memorize facts/ definitions/ formulas	Perform procedures/ conduct investigations	Communicate understanding of science concepts	Analyze information	Apply Concepts/Make connections
0 1 2 3	A	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
0 1 2 3	B	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
0 1 2 3	C	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
0 1 2 3	D	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
0 1 2 3	E	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
0 1 2 3	F	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3

2.10.3.2. A single alignment statistic: The same SEC protocol is used for describing content standards, assessment, instruction, instructional materials. Therefore, every analysis provides the matrix with same order i.e. equal number of cells. The quantitative measure of alignment is got by using the following formula:

$$\text{Alignment Index} = 1 - \frac{\sum(X-Y)}{2} \quad \text{(Porter, 2002)}$$

Where *X* stands for value on one cell of a matrix and *Y* stands for value in corresponding cell of other matrix. The values of the alignment index may range from 0 to 1.0 with 1.0 indicating perfect alignment.

2.10.3.3. Graphical output: Visual display of the alignment results (as shown in Figure 2.7) is a distinctive feature of SEC alignment method. This visual display of alignment results has following advantages:

- It displays visual summary of where there is difference of coverage,
- It facilitates locating the points of good alignment and poor alignment,
- It makes easy for the researchers as well as practitioners for the interpretation of alignment data.

(Roach, Niebling & Kurz, 2008, p. 164)

Porter and Smithson (2002) assert that SEC model has following three major advantages over other models of curriculum alignment measurement:

a) It can be employed to quantitatively measure alignment vertically i.e. among standards, instruction and assessment as well horizontally i.e. across states or other standards.

b) SEC employs an efficient process for alignment measurement e.g. it uses efficiently multiple raters with increased stability of estimates; teachers have to spend less time and report on whole year.

c) It provides space for third party validation. (p. 3)

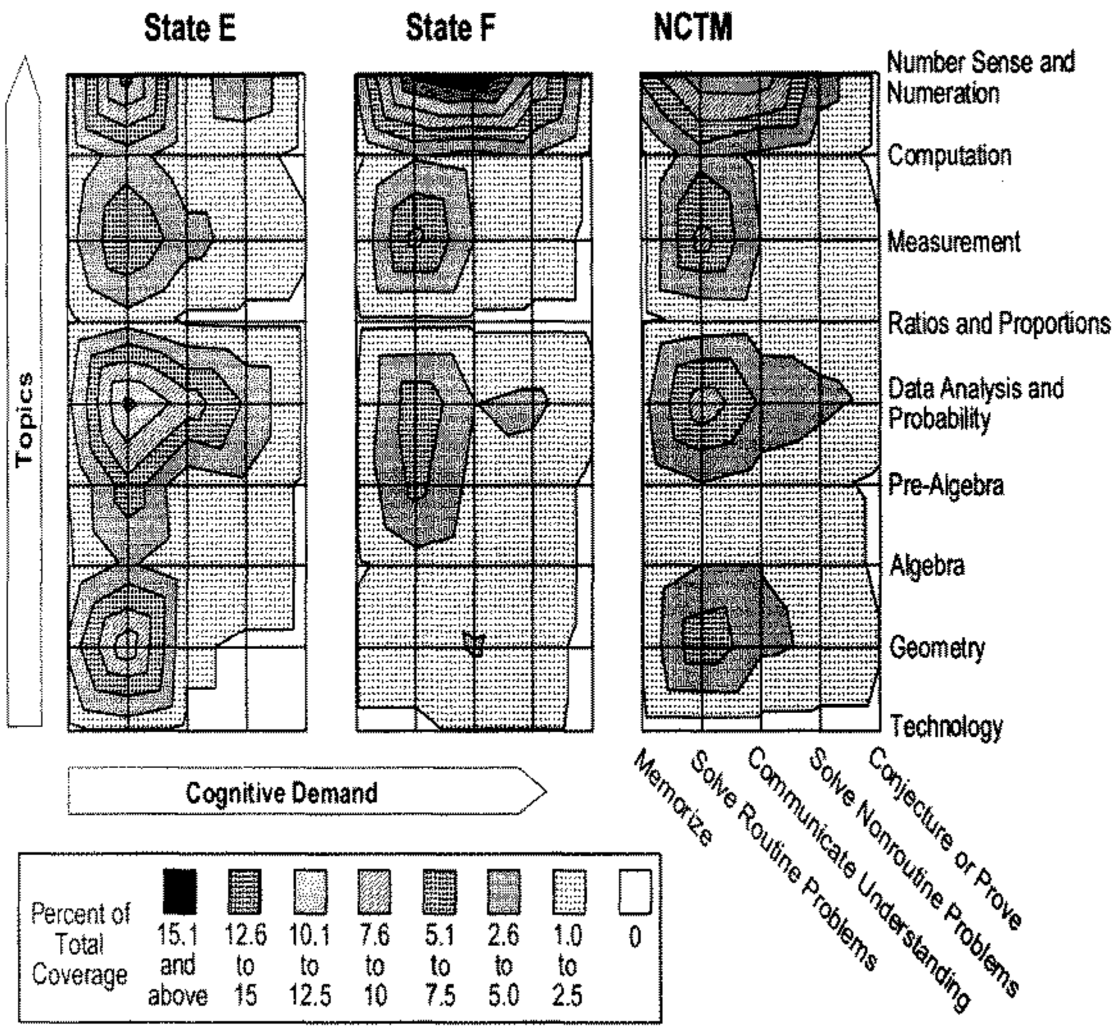

Figure 2.7. Specimen of content graph (Porter, 2002, p. 8)

Porter (2002, pp. 8-9) claims that SEC tools are powerful instrument for measuring content and alignment between the written, taught, and assessed curricula because validity of data obtained through SEC has been confirmed by a number of studies. However, he also admits that the SEC model has following weaknesses:

- The surveys are restricted to developers prior choices
- End-of-year surveys may suffer from self-report bias
- The surveys cannot capture the complex instructional practice
- The surveys are not so good for measuring the quality of instruction

2.11. Significance of Curriculum Alignment

2.11.1. Advantages of Curriculum Alignment

Alignment means congruence among different types of curriculum. The written curriculum is a written plan developed by the educational stake holders including educationists, subject specialists, psychologists, administrators, teachers, and parents. It guides the teachers to deliver the instruction. It also bounds the evaluators to assess the students according to the given guidelines. It helps the administrators to provide sufficient resources for proper implementation of the curriculum. Thus curriculum alignment helps at every level that is planning, instruction, and evaluation.

According to Flowers and Ahlgrim-Delzell (2005), for improving teachers' instruction as well as students' learning it is essential that written curriculum, classroom instruction and assessment are highly aligned.

The teaching that is aligned with the national standards would ensure better performance of the students in the public examinations (Lambert, et al., 2002).

Moreover, if the instruction is aligned with the standards, the disadvantaged students show significant academic improvement.

The fundamental purpose of curriculum alignment is to devise the learning activities as well as assessment in such a way that facilitates the learners in achieving the intended outcomes (Kuhn & Rundle-Thiele, 2009, p.352).

Similarly, Contino (2012, p. 64) argues that an aligned system ensures following three benefits:

a) Setting priorities effectively,

b) Allocating resources accurately, and

c) Fostering likelihood of achieving the same ends.

2.11.2. Limitations of Curriculum Alignment

Although so many educationists have stressed on the significance of curriculum alignment, several others have also voiced against curriculum alignment. These educationists have pointed out disadvantages of alignment. The major disadvantage of curriculum alignment is loss of freedom and individuality of students as well as teachers. There is no such thing as personalization which is so much emphasised by John Dewey. Emphasis on curriculum alignment and standardization has resulted in the loss of individual child as the teachers cannot individualize the lessons according to the diverse needs of the students (Mahiri, 2005, p. 82; Pieratt, 2010, p. 52). Following are the major disadvantages of curriculum alignment as pointed out by various educationists:

- It curbs self-reflection and critical thinking (Giroux, 2010; Massa & Pinhasi-Vittorio, 2009; McLaren, Martin, Farahmandpur, & Jaramillo, 2004).

- It makes teachers and students just puppets and learning is confined to success in tests (Hursh, 2008; McNeil, 2005).
- It diminishes the enjoyment in learning and spoils the academic experience of the learners (Berry, 2009; Hampton, 2005).
- It makes students just receptor of knowledge rather than producer of knowledge.
- It adds to the frustration of the teachers as it diminishes the role of teacher (Crocco & Costigan, 2007).
- It does not result in increased students' learning (Horn, 2003).
- There is no significant data behind the perception that alignment really results in increased students' learning (Amrein & Berliner, 2003).
- It converts school to a "corporation" rather than inspiring places satisfying the learners' needs (McLaren & Farahmandpur, 2006).
- It is a threat towards teachers, students, and the future of society (Rubin & Kazanjian, 2011).

Curriculum covers pretty extensive content. So, many educationists believe that curriculum alignment compels the learners to grasp all the content, consequently, the learners cannot get mastery of content and their grip of the content is superficial (Schmidt, et al., 2001). Therefore, these experts advocate that mastery of less content is better than shallow coverage of wide content.

2.11.3. Curriculum Alignment: Valuable or Worthless

Considering the advantages and disadvantages of curriculum alignment, it is clear that alignment is good if the drawbacks pointed out by various experts are addressed properly. For example, (a) the curriculum is flexible enough to endorse learners' individuality. (b) It is not overloaded and targets are set in such a way that these are not only achievable but also allow the deep understanding for learners. (c) The resources provided for curriculum implementation are sufficient and aligned with the curriculum. (d) The assessed curriculum is aligned with the written curriculum (e) the curriculum implementers have deep understanding of the curriculum.

2. 12. Previous Studies on Curriculum

Saglam (2011) conducted study to analyze the teaching materials used during social studies classes. He used self developed questionnaire as data collecting instrument and concluded that professional development plays a key role for filling the gap between the potential and current use of resources for instruction. It is very important in the context of developing countries like Pakistan which have limited resources. If the available resources are utilized effectively, it may mitigate the effect of shortage of resources to some extent. Fulmer (2011, pp. 381-402) in his study entitled "Estimating critical values for strength of alignment among curriculum, assessments, and instruction" stressed on the "alignment of tests with the state's standard documents" and expressed his dissatisfaction on the lack of established criteria for determining the alignment. He re-examined the results of the previous studies using Porter's alignment index and proposed a table of critical values for judging the "strength of alignment of standards, assessment, and instruction". His proposed table of critical values of alignment index is very important for the studies on curriculum alignment.

Contino (2012) has analyzed alignment between national standards, state curriculum, and assessment in the New York state. He found that state curriculum was 49% aligned with the national standards and the assessment was 27% aligned with state curriculum. Moreover, he suggested revising the national standards and updating the state curriculum. The recommendations of Contino's (2012) study show that it is not only the assessment which is responsible for misalignment but the state standards have also important role in alignment. Therefore, after alignment measurement studies, the state standards may be revised to make them achievable.

Liu and Fulmer (2008) examined alignment between the science curriculum and assessment in NY State regents' exams in the subjects of physics and chemistry by using Porter alignment index. They found that curriculum was highly aligned with the assessment. However, there was difference of emphasis on the cognitive levels as well as topics. They suggest that, for a comprehensive alignment, state standards should specify the instructional methodologies as well as the resources needed to teach the content (p. 382). This is very important issue for discussion that either the state standards should also clearly guide about the instruction methodologies as well as instructional resources.

Polikoff (2012) analysed alignment of instruction with the content of standards and assessment. Employing SEC method, he analysed state standards, assessments and instruction for the subjects of mathematics, science, and English/language arts (ELA). He also explored the trend in instructional alignment during the period from 2003 to 2009. He found that the alignment increased during this period. Polikoff (2012) has effectively employed SEC curriculum alignment measurement method and his study is good example for understanding the SEC curriculum alignment measurement method.

Çepni and Karab (2011), using Webb's (2007) alignment measurement model, investigated alignment of Turkish Biology Curriculum with the examinations. They found that curriculum and the assessment were highly aligned with reference to two criteria i.e. depth of knowledge and categorical concurrence. However, there was low alignment on the two criteria i.e. range of knowledge and balance of representation. They recommend that (a) content as well as the nature of test items must be critically analysed by the policy makers, and (b) the concepts for teaching of biology should be expanded (p. 3226). However, they do not propose how teaching of biology can be expanded. They have also not given reasons for misalignment of assessment with respect to 'range of knowledge' and balance of representation.

Kurz, Elliott, Wehby and Smithson (2010) used SEC to evaluate the alignment between standards, taught and learnt curricula and found that taught curriculum was not sufficiently aligned to standards. They also found that there was a positive correlation between the taught curriculum which is aligned to standards and students' achievement. This is very important and confirms the fact that instruction aligned with the curriculum has a positive effect upon students' achievement.

Davis-Becker and Buckendahl (2013) have proposed a model for evaluating the alignment studies. They have discussed the possible threats to validity from the beginning of alignment studies up to the reporting. They have given ways and means to eliminate or minimize these threats to validity. Their model is very significant for curriculum alignment measurement studies. The present study was also validated by applying this model.

In a study, Naeem Ullah (2007) compared curriculum, teaching methodology and examination system of A-Level and F.Sc. He found that modern technology was not being used in instruction for F.Sc. teaching (p. 150) and that the examination system for F.Sc. "focused on cramming of knowledge" (p. 152). However, he did not analyze items of the question papers for exploring the nature of content these papers assessed.

Rehman (2004) found that assessed curriculum of science subjects in Pakistan encouraged "cramming and rote learning" rather than complex cognitive processes. He recommended teachers' involvement and need analysis in the process of curriculum development. He advised to provide sufficient audio visual aids to teachers for improving teaching/learning process. However, he did not compare the assessed and supported curriculum with the written curriculum.

Malik (2002, pp. 279-284) proposed a model of curriculum for physics titled "the Socio-Techno-Oriental Model" [STOrM] which is a three-dimensional model consisting of societal/ sociological, oriental/religious, and scientific/technological view points. Here, he suggests a bottom-up approach to enable the learners to adapt to the "world of work". This approach focuses on the learners and the curriculum developed through this approach will be more student-oriented and flexible. Moreover, Alignment of instruction and assessment will be easy.

Shah and Tariq (1986-87) analysed the relationship between the biology textbook and examination for secondary level and found that questions were set from the specific (only 20%) part of textbook. They also found that paper setters had not given proper representation of content from every chapter (p.45). This hints towards misalignment of assessment with the written curriculum as well as the textbook. This also indicates lack of validity of examination at secondary level.

Kanwal (2001) evaluated textbook as well as examination questions in the subject of English on the basis of Bloom's taxonomy of objectives and found that mostly examination questions were from selected chapters and questions that fall in the evaluation category of objectives were given neither in the textbook nor in the examination papers (pp. 59-60). She recommended that there must be balance of distribution of items relating to categories of objectives in the textbook and the examination papers. However, the tool employed by her was questionnaire. The content analysis of the question papers would have developed more reliable results.

Faize (2011, pp. 209-213) in his study entitled "Problems and prospects of science education at secondary level in Pakistan" found that in Pakistan, the examination encouraged rote learning and ignored higher order objectives of cognitive domain, science content was overloaded, less time had been allocated for science subjects teaching, and teachers encouraged memorization and pay less emphasis on understanding. The findings of Faize (2011) endorse those of Naeem Ullah (2007). However, comparison of content of textbook and examination with the written curriculum would have generated quantitative results and it would have helped in finding the irrelevant content and the content required objectives.

Akhtar (2004) in his doctoral study entitled "Analysis of the curriculum process and development of a model for secondary level in Pakistan" found that (a) required resources for the implementation of the curriculum were not available in the schools, (b) teachers employed teaching methods which did not help students in understanding of concepts, and (c) there was lack of coordination among curriculum development and curriculum implementation institutions. Thus, his research indicates that there may be misalignment among the written curriculum, the supported and taught curriculum. However, his finding about lack of coordination between curriculum developers and curriculum implementers is very important. It is necessary to bridge up this gap.

Naeem Ullah's (2007) finding about the lack of use of modern instructional material indicate teachers do not follow written curriculum which recommends use of modern instructional technology. Similarly, research studies (Faize, 2011; Kanwal, 2001; Rehman, 2004; Shah & Tariq, 1986-87) found that assessment encouraged rote memorization. This indicates that assessment was limited to lower level of objectives contrary to recommendations of written curriculum. Akhtar (2004) also analysed the instructional methodologies, available resources, and process of curriculum development. All these studies suggest lack of alignment of taught and assessed curricula with written curriculum. However, most of these studies have analysed taught curriculum, assessed curriculum or supported curriculum independently. Some studies have compared instruction or instructional materials with the written curriculum only qualitatively. But these studies have not analysed different types of curriculum quantitatively by applying curriculum alignment measurement models. Moreover, these studies have not explored the comparison up to students learning outcomes level. Therefore, present study was undertaken to analyse the level of alignment quantitatively. It also analysed various types of curricula simultaneously. Moreover, the comparison was made on the basis of students learning outcomes mentioned in the curriculum. This comparison would help in understanding of how much the secondary education in Punjab have succeeded in achieving the proposed learning outcomes. Moreover, it would also highlight the learning outcomes which are being ignored partially or completely.

2.13. An Overview of Curriculum Development and Implementation in Punjab

2.13.1. Federal Ministry of Education [MOE]

Education in Pakistan has been essentially a provincial responsibility. However, for preservation of national ideology, solidarity and unity, some educational functions such as educational policy formulation, curriculum development, and approval of text books were on the concurrent list of the Constitution of Pakistan before 'The Eighteenth Constitutional Amendment Act 2010' (GOP, 2010). The 'Federal Supervision of Curricula, Textbooks and Maintenance of Standards of Education Act, 1976' empowered Federal Ministry of Education [MOE] to supervise the educational matters present on the concurrent list. National Bureau of Curriculum and textbooks [NBCT], working under the Federal MOE, was a nominated 'competent authority' for performing the following functions for the classes from primary to higher secondary level:

a) Develop curricula, scheme of studies, and manuscripts of textbooks

b) Approve Textbooks' manuscripts

c) Modify/improve/ correct the curriculum and the textbooks or reference materials

NBCT have been performing its functions since its establishment. However, "comprehensive national curriculum reforms" were undertaken in 2005 (Jamil, 2009). The present 'National Curriculum 2006' was developed after extensive consultation with the educational stake holders including administrators, curriculum experts, educationists, teachers, and students (Aly, 2007). The main features of this curriculum are:

a) It is standards and competencies driven

b) Learning objectives correspond to students' learning outcomes (SLOs)

c) It has adopted progressive approaches for vertical alignment

d) It integrates life skills

e) It is vertically and horizontally integrated

f) It promotes creative and analytical thinking

g) It gives framework of evaluation. (Majeed, 2009, pp. 2-4)

2.13.2. School Education Department Government of Punjab

School Education Department [SED] Government of Punjab is responsible for all the functions related to education up to higher secondary level. Major functions of this department are as under:

a) Policy formulation as well as planning,

b) Maintaining standards of education including curriculum development and production, publication, distribution of textbooks as well as educational and scientific films.

c) Monitoring and evaluation system through Punjab education assessment system and Student assessment and terminal examination of Grade-V and VIII elementary education through Punjab Examination Commission.

d) Pre-service and in-service teachers training. (Government of Punjab School Education Department, 2013)

The SED executes the above responsibilities through its institutional set up as well as attached organizations which are as under:

- Directorate of Public Instruction (Secondary Education)
- Directorate of Public Instruction (Elementary Education)
- Directorate of Staff Development (DSD)

- Children Library Complex Punjab
- Punjab Education Assessment System (PEAS)
- Punjab Textbook Board
- Punjab Examination Commission (PEC)
- Punjab Education Foundation Punjab Teachers Foundation
- The Punjab Daanish Schools and Centers of Excellence Authority
- Boards of Intermediate and Secondary Education

2.13.3. Punjab Textbook Board [PTB]

Since its establishment in 1962, Punjab Textbook Board [PTB] (formerly West Pakistan Textbook Board) has been assigned the responsibility of implementing the policies of Government regarding development/selection of textbooks and textbooks related matters. The major functions of PTB are:

- Preparation, publication, marketing and distribution of:
    a. textbooks,
    b. supplementary reading materials,
    c. teachers training courses, and
    d. teaching aids.
- Maintaining reference and research materials concerning curriculum and textbook issues
- Conducting training courses for the writers, reviewers, designers, editors of textbooks
- Holding seminars and workshops for effective use of textbooks and other materials

- Conducting research in curricula, textbooks, other reading materials and teaching aids (Punjab Textbook Board, 2012c)

The quality of textbooks in Pakistan has been much criticised. Therefore, Government of Pakistan approved 'National Textbook and Learning Materials Policy & Plan of Action (2007-2010)' to introduce "a well regulated system of competitive publishing of textbooks and learning... [through] enhanced public-private partnership... [so that] Textbook Boards are transformed into competent, facilitating, regulating and monitoring authorities" (GOP, 2007, p. 2-4).

A brief description of process of textbook development in Punjab is given in Figure 2.8.

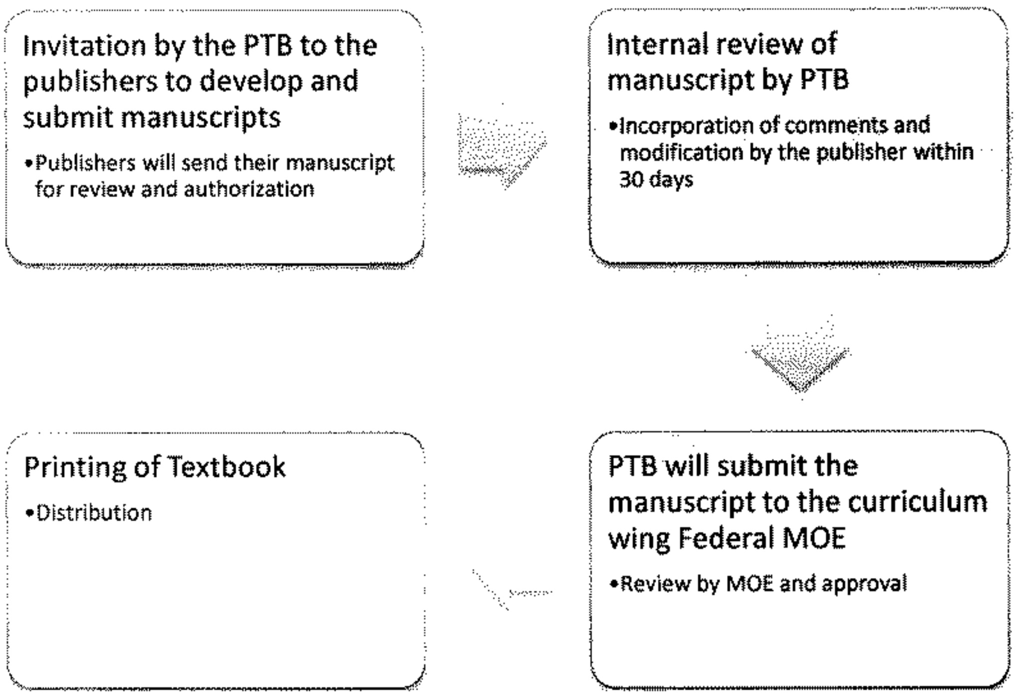

Figure 2.8. Process of textbook development in Punjab (Source: Punjab Textbook Board, 2012c)

After the approval of 'The Eighteenth Constitutional Amendment Act 2010', the provinces are independent in all the matters relating education. So, the federal MOE has been dissolved and now there is no need to get approval from federal MOE. Moreover, the provinces are authorized to develop the curriculum for the schools in the provinces. Therefore, the Punjab Provincial Assembly has approved 'The Punjab Curriculum Authority Act 2012' for the establishment of Curriculum Authority to regulate and supervise the curricula, textbooks, allied materials, and maintenance of standards (Government of Punjab, 2012).

12.3.4. Boards of Intermediate and Secondary Education [BISE]

Evaluation of students' learning occupies a key position in any education system. Both formative and summative evaluation is conducted in all the schools in Punjab. However, the annual examinations at the end of academic year are considered the chief criteria for promoting the students to next grade. The terminal exams (end of the year) fall in following categories:

- Internal Examination (Conducted by the school for its enrolled students): For Grades 1-4, and 6-7
- External Examinations: For Grades 5 (Conducted by PEC), and 9-12 (Conducted by BISEs)

Currently eight Boards of Intermediate and Secondary Education [BISEs] are functioning at divisional level in Punjab. These BISEs conduct the examinations for the assessing secondary and higher secondary students through standardized tests held for every one of the classes from Grade 9 to 12. The students are awarded degrees of (a) Secondary School Certificate [SSC] (Matric) and (b) Higher Secondary School Certificate [HSS] (FA/FSC) at successful completion of Grade 9 & 10 and Grade 11

& 12 examinations respectively. For promoting coordination, uniformity and exchange of information, the federal MOE established The Inter Board Committee of Chairmen [IBBC]. This committee has its head office in Islamabad and four sub offices in every one of the provinces.

Some of the pitfalls in the examinations conducted by BISEs are as under:

- Evaluation is narrow in scope (Khan, 2006).
- The evaluation conducted is sporadic and subjective, it provides no feedback to the learners for improvement (Khattak, 2012, p. 7).
- Getting only highest position in examination is the sole objective for all i.e. schools, teachers, and students (Rehmani, 2003, p. 3).
- There is much repetition of the same topics/questions (Christie & Afzaal, 2005; Shah & Afzaal, 2004).
- Modern methods and techniques of evaluation are not employed (Christie & Khushk, 2004).
- Tests have low validity and reliability (Khan, 2011; Rehmani, 2003).
- There is lack of professionally trained staff for testing (Mirza, Nosheen, & Masood, 1999).

BISEs have taken several initiatives to minimize the deficiencies. There are eight BISEs in Punjab. Through the provincial IBCC, it has been attempted to make the process of examination equivalent throughout the province. There are same dates of examinations in all Punjab. Moreover, all the paper setters for a subject gather at one place. They are first given the training for setting papers. The question papers are separately set by every one of the paper setters. These question papers are then mixed and given randomly to different boards. Moreover, the papers conducted by one board are marked by the teachers of other boards.

The examinations for secondary classes are held biannually. First examination is usually held in March and is called annual examination while the second is held in October and is called supplementary examination. The students first time appear in the annual examinations. So, the entire students admitted in the affiliated schools appear in the annual examination. The supplementary examination is for those students who fail or want to improve their marks. Moreover, there are separate papers for Grade IX and Grade X. The students who cannot get pass marks in the Grade IX paper(s), have to appear in the next annual examination and then take the papers of failing subject(s) with the Grade X examination.

For being successful, it is necessary that a student gets at least 33% marks in every subject. Moreover, there is also 33% choice in subjective part of the examination paper. The chapter-wise and category wise specification table given by the BISEs is shown in Tables 2.8 & 2.9. The questions concerning the practical (skills) are also included in the theory paper. However, there is also practical examination at the end of Grade-X theory examination. The achievement of the students in this practical is shown in the marks sheet separately in the form of grades. It is interesting to note that even if a student is not able to obtain 33% marks in the practical portion still he is considered to be successful.

All the BISEs have tried to formulate equivalent standard of examination in all respects. For this purpose, they divide the subjects among all the BISEs, and every BISE develops question papers of certain subjects assigned to it. This BISE arranges training and meeting of all the paper setters of that particular subject(s). Every BISE sends its paper setter to this BISE. All the representatives, after training, develop five question papers individually. These question papers are packed and sealed and from these question paper Chairman of every BISE takes the question papers randomly. Moreover, there is same date sheet across the province. The answer sheets of science groups are exchanged for marking so that these answer scripts of the students of one BISE are marked by other BISE.

Table 2.8

Specification Table Biology Grade IX

Ch. No.	Chapter	Percentage	Marks	knowledge	comprehension	application	Skills
1	Introduction of Biology	10%	10	3	3	4	
2	Solving a Biological Problem	5%	5	1	2	2	5 marks
3	Biodiversity	9%	8	3	3	2	
4	Cell Cycle	9%	9	2	3	4	
5	Cells and Tissues	16%	15	3	10	2	
6	Enzymes	10%	10	3	7		5 marks
7	Bioenergetics	8%	8		3	5	
8	Nutrition	17%	17	3	8	6	5 marks
9	Transport	16%	15	4	9	2	
Total		**100%**	**97**	**22**	**48**	**27**	**15**

(BISE Multan, 2013)

Table 2.9

Specification Table Biology Grade X

Ch. No.	Chapter	Percentage	Marks	knowledge	comprehension	application	Skills
10	Gaseous Exchange	11%	11	2	7	2	
11	Homeostasis	11%	10	3	4	3	
12	Coordination & Control	13%	12	8	3	1	
13	Support & Movement	10%	10	3	7		15 marks
14	Reproduction	13%	13	7	3	3	
15	Inheritance	12%	12	2	7	3	
16	Man & His Environment	10%	10	3	2	5	
17	Biotechnology	12%	12	5	6		
18	Pharmacology	8%	8	6	2		
	Total	**100%**	**97**	**39**	**41**	**17**	**15**

(BISE Multan, 2013)

2.14. The National Curriculum for Biology-2006

One of the main goals of education is to enable the learners to adjust well in the society. But, society changes with the passage of time. So, education is not a static process. It is a dynamic process-modifying itself with the changes occurring in society. Therefore, curriculum is reviewed and revised continually. The present curriculum of Biology for secondary classes was developed in 2006. The major reason of revising the previous curriculum developed in 2000 was shift of educational paradigms, particularly from teacher-centred to learner-centred and supremacy of learners' experience and involvement over the teachers' activity. The National Curriculum 2006 for Biology aimed at enabling "all students to develop their capacities as successful learners, confident individuals, responsible citizens and effective contributors to society" (GOP, 2006a, p. 1). It also endeavours to enable the learners to attain such knowledge and skills as make possible to meet the challenges of global community in the new millennium.

The National Curriculum document consists of twelve chapters. The first chapter gives the rationale of the new curriculum, describing the *raison d'être* of the revision of the existing curriculum and the strategy adopted for development as well as design of present curriculum. The aims and objectives intended to develop in the learners are given in Chapter 2 of the present curriculum.

Shifting of education system from input-based to an outcome based one is a revolutionary change in education system of the world in the 21st century (Woolard, 2007). This outcome based system stresses on student achievement/ learning rather than instructor's activities. Therefore, the national curriculum has also recommended learning outcomes in three steps which are:

- Standards
- Benchmarks
- Learning outcomes

Standards have been defined in the National Curriculum as "broad descriptions of the knowledge and skills which students should acquire in a subject area" (GOP, 2006a, p. 7). Basically standards aim at promoting higher order thinking, deep knowledge, substantive conversation, and real world connections.

In order to make curriculum relevant to age and intellectual level as well as to describe the performance of students from Kindergarten to Higher Secondary level, a framework of five developmental levels has been identified. These five developmental levels are given in Table 2.10.

Table 2.10

Developmental Levels

Developmental Level	Grades
I	0-3
II	4-5
II	6-8
IV	9-10
V	11-12

Specific benchmarks have been proposed for a particular developmental level. Chapter 3 of the curriculum gives the standards and benchmarks for Biology for Grades IX &X. There are 13 standards and 28 benchmarks specified for the subject of biology at secondary level.

The learning outcomes are more specific and are given for every topic in the subject. These learning outcomes "determine how well students are performing and will assure that all students are measured on the same knowledge and skills using the same method of assessment" (GOP, 2006a, p. 7). These outcomes are "realistic, observable, achievable and measurable" (GOP, 2006b, p. 5). The relationship among standards, benchmarks and learning outcomes is shown in Figure 2.9.

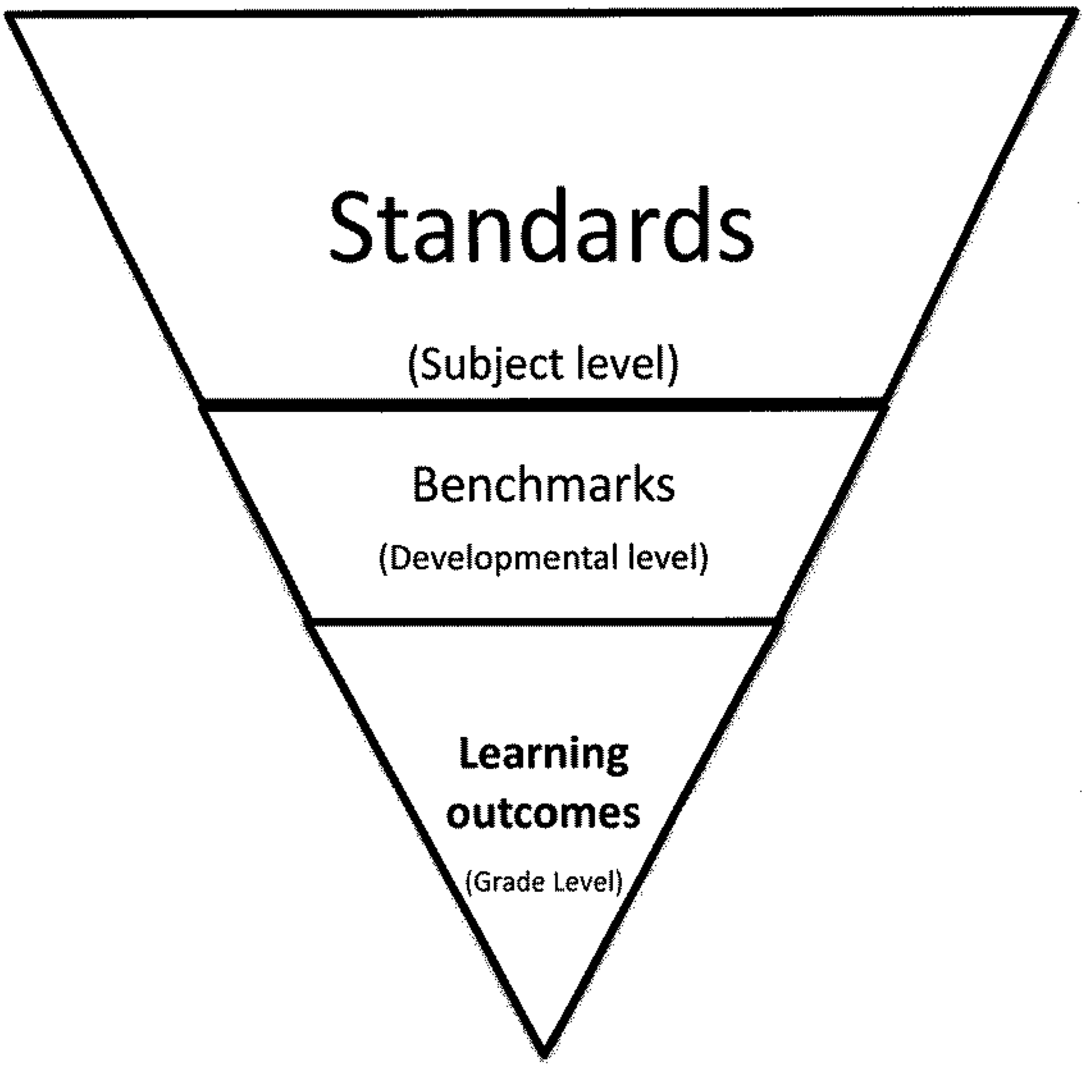

Figure 2.9. Standards, Benchmarks and Learning outcomes

Chapter 4 describes the contents for Biology Grades IX & X by outlining content in the form of chapters, major concepts and subtopics. Overall, the content has been divided into six major themes which are:

1. Study of life and biodiversity

2. Cell biology

3. Life processes

4. Continuity in life

5. Ecology

6. Application of biology

These major themes have been expanded through 76 topics and 60 subtopics. These topics have been grouped into 18 chapters.

Chapter 5 outlines the learning outcomes. These outcomes are given chapter-wise for every topic listed in the themes. However, before listing the outcomes, conceptual linkage and overview of every chapter as well as proposed number of periods for every topic has been given.

The learning outcomes are of three types:

- *Understanding* (Relating to five categories of cognitive domain: Knowledge, Comprehension, Analysis, Synthesis and Evaluation (in accordance with the Bloom's classification of objectives (Bloom, 1956))
- *Skills* (Comprising the skill outcomes which are Initiating and Planning, Analyzing and Interpreting, Performing and Recording, and Communication)
- *STS Connections* (i.e. Science-Technology-Society connections)

There are total 537 learning outcomes, out of which 332 (61.8%) are related to category understanding, 129 (24%) to skills, and 76 (14.2%) to STS connections. For external evaluation the proposed weightage is given in Table 2.11.

Table 2.11

Weightage of learning domains in external evaluation

Learning Domains for measurement	Weightage
Knowledge, Comprehension, Analysis, Synthesis and Evaluation	85%
Skills of Communication, Initiating and Planning, Designing experiments and Interpreting, and Interpreting data	05%
Sensori-motor skills (Performing lab work)	10%

(GOP, 2006a, p. 83)

Chapter 6 lists chapter-wise practicals (total 50 practicals) as well as the material and apparatus needed to perform these practicals. Chapter 7 describes chapter-wise time allocation and a total of 360 periods have been recommended for teaching biology to IX and X grades. Chapter 8 gives guidelines about the assessment and evaluation. Here, both formative and summative assessment has been advocated.

Chapter 9 illustrates the instructions and suggestions for the execution of the curriculum. It states guidelines for textbook development, criteria for selection of learning materials, and need of teachers' training. In chapter 10 the salient features of the curriculum are given, while chapter 11 is about glossary of terms and chapter 12 lists the members of the curriculum development team.

2.15. Biology Textbooks (for Grades IX- X)

Biology 9 & Biology 10 are two textbooks for Grades IX & X respectively. On the very first page of the each book is certificate that it has been approved by Federal MOE and that it has been written in accordance with the National Curriculum 2006 (Punjab Textbook Board, 2012a, b). The contents of the Biology 9 textbook have been divided into three sections (study of life and biodiversity, cell biology and life processes) while that of the Biology 10 into four sections (life processes, continuity of life, ecology and applications of biology). Each of the two books is further dived into nine chapters. This division of content into sections and chapters is according to the written curriculum. Every chapter specifies the number of periods for instruction. Every chapter starts with the introduction giving its link with topic(s) that the students have already studied in the previous grades. The contents are complemented with tables and graphics. The topics'/subtopics' titles are in accordance with the curriculum. The review questions, key terms, learning outcomes of the chapter and useful online learning resources are given at the end of the every chapter. The books end with the recommendations for further reading and the glossary of key terms.

Table 2.12

Analysis of Number of Pages per Period of Biology Textbook 9

Chapter No.	**Number of**			**Difference from average**
	Periods	**Pages**	**pages/period**	
1	6	18	3.0	+0.9
2	4	11	2.8	+0.7
3	8	20	2.5	+0.4
4	17	35	2.1	0
5	11	20	1.8	-0.7
6	7	10	1.4	-0.7
7	10	22	2.2	+0.1
8	17	31	1.8	-0.3
9	16	38	2.4	+0.3
Total	96	205		
Average No. of pages per period			**2.1**	

In these textbooks there is no consistency in the number of pages to that of period. The average number of page per period for Biology 9 is 2.1 and that of Biology 10 is 1.3. The range of difference from average number of pages per period in Biology 9 is from -0.7 to +0.9 while that of Biology 10 is –0.3 to +0.4 (Tables 2.12 & 2.13).

Table 2.13

Analysis of Number of Pages per Period of Biology Textbook 10

Chapter No.	**Number of**			**Difference from average**
	Periods	**Pages**	**pages/period**	
10	10	16	1.6	+0.3
11	12	14	1.2	-0.1
12	19	25	1.3	+0.1
13	11	12	1.1	-0.2
14	16	24	1.5	+0.3
15	16	18	1.1	-0.2
16	16	24	1.5	+0.2
17	12	12	1.0	-0.3
18	10	9	0.9	+0.4
Total	122	154		
Average page per period			**1.3**	

The digital version of both of these books with online resources is also freely available on Punjab School Education website.

2.16. Critical Analysis

The written curriculum is a major component of education system and a crucial indicator of quality education. It reflects knowledge, skills and attitudes that a society wants to transfer to the next generation. Therefore, it is necessary that this key document should be followed during classroom-instruction and students' assessment. This would be possible if required educational resources are provided for proper implementation of the written curriculum. The responsibilities of every stake holder in the hierarchy of educational system revolve around the implementation of the written curriculum. Hence, proper coordination among these stake holders would enhance the suitable execution of written curriculum. Curriculum audit, curriculum mapping and curriculum alignment are different approaches for curriculum coordination and all these efforts help in effective implementation of curriculum.

Educationists (e.g. Blankstein, 2004; Evans, 2005; Lavin-Loucks, 2006; Rubin and Kazanjian, 2011; Schuenemann, Jones, and Brown, 2011) have rightly claimed that curriculum alignment ensures improvement in students' academic performances and intellectual abilities by motivating teachers to facilitate students in achieving the learning outcomes proposed in the written curriculum. However, the number of those educationists who are against curriculum alignment is also not less. The major drawback of curriculum alignment is that it curbs the creativity of teacher and forces him to follow a fixed pattern.

Every one of the curriculum specialists has suggested different factors that improve curriculum alignment. Summarizing the literature reveals that important factors which enhance curriculum alignment are (a) rationalized standards (b) political support (c) educational management (d) teachers (e) teachers' pre-service education (f) available instructional resources, and (g) accountability system.

Although various models of curriculum alignment have been proposed by different authors, the fundamental point in these models is to see if the written, taught and assessed curricula are congruent with one another. To measure the alignment level quantitatively, various curriculum alignment measurement models have been proposed. Among these models SEC model is more comprehensive in the sense that it can be used for alignment measurement among written, taught, assessed, and supported (textbooks) curricula.

Analysis of the studies conducted in Pakistan about different types of curriculum shows that Pakistan's education system abounds in drawbacks and it is in too miserable state. On the other hand, the institutions responsible for implementation of curriculum (e.g. MOE, SED, BISEs, PTB) claim to be performing well in this regard. It is really strange, if there is no positive point in the education system of Pakistan. Therefore, before establishing any opinion about education system in Pakistan, it is necessary, to conduct study about the validity and reliability of these studies or opinion.

Among main features of National Curriculum 2006, it has been claimed that it promotes creative and analytical thinking. However, the number of SLOs relating to higher order domain is much less. So, it is surprising how creative and analytical thinking can be promoted when majority of SLOs relate to lower order level of cognitive domain.

2.17. Chapter Overview

Descriptive definitions of curriculum focus on the learner but these definitions disapprove planning because these are concerned with what is happening with the students. On the other hand, prescriptive definitions (which are given by renowned educationists like Dewey and distinguished curriculum leader like Tyler) focus more on the role of institution and think curriculum as a planned activity. If we combine these two types of definitions, curriculum becomes something that is planned with the focus on the learner. Glatthron, Boschee, and Whitehead (2006) have defined curriculum in this way as they think it is a proposed documented plan for guiding learning that is put into practice in the classroom in a learning environment. Here, emphasis is upon students learning outcomes. Therefore, Glatthron, Boschee, and Whitehead's (2006) definition of curriculum formed the basis of this study which analysed the curriculum alignment with reference to students learning outcomes.

Although curriculum alignment also has some limitations, its advantages are greater. Moreover, its drawbacks can be minimized if written curriculum is properly developed. Among different curriculum alignment models, English and Steffy's (2001) alignment model is more comprehensive as it seeks to find degree of congruence among written, taught and assessed curricula. It evaluates the assessment in relation to the goals and objectives mentioned in the written curriculum. This model has been also employed by other educationists in their studies of relationship between different types of curricula. However, this model ignores the instructional materials. Anderson' (2002) model of curriculum alignment highlights the significance of alignment of instructional materials which play a key role in alignment among written, taught, and assessed curricula. Therefore, English and Steffy's (2001) and Anderson' (2002) curriculum alignment models contributed as conceptual basis of study.

Among the several curriculum alignment measurement models, Webb's alignment model, the Surveys of Enacted Curriculum (SEC) model, and the Achieve model are more famous for measuring curriculum alignment. However, Webb and Achieve models of curriculum alignment measurement provide good statistical tools for comparing the alignment between the written curriculum and the assessment. On the other hand Surveys of Enacted Curriculum (SEC) model is unique in the sense that it offers tools for quantitative comparison of the extent of alignment among curriculum, classroom instruction, instructional materials (such as textbooks), and assessment. Moreover, it provides method to present the results visually in the form of topographical maps which makes the interpretation of data easy. As the present study intended to analyse alignment of taught, supported, and assessed curricula with written curriculum, so the SEC model of curriculum alignment analysis was more suited and this model was employed for collection as well as interpretation of data.

Flick (2006, p. 41) has suggested that the researcher moves from "the theoretical knowledge taken from the literature or earlier empirical findings" to testing of hypotheses. So, after review of relevant literature, complete methodology and the steps taken to undertake the study have been presented in the next chapter (Chapter 3).

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of the study was to determine alignment level of supported curriculum, taught curriculum, and assessed curriculum with the written curriculum at secondary level in Punjab. This chapter discusses the method and procedure adopted to achieve objectives of the study. The chapter starts with an overview of the research paradigms. After describing population and sample, the research instruments as well as application of these instruments have been discussed. Finally, a brief description of analysis of the data gathered through the research instruments has been given.

3.1. Research Paradigms

The positivism worldview, also known as the scientific method, stresses on the need to find out causes which influence outcomes. As a research paradigm, it is widely used for verification of theories. Since, the present study aimed to verify alignment, so this philosophical worldview was appropriate for the study. Survey method was used to conduct this inquiry. The paradigms of the present study are depicted in figure 3.1.

Quantitative research approach is application of research methods of natural science to explore the educational world (Scott & Morrison, 2007, p. 185). Application of quantitative approach in social sciences takes social reality as objective truth which can be measured scientifically. Results of studies adopting quantitative approach are based on valid and reliable data, and these results can be generalized.

Figure 3.1. A framework of research design

Creswell (2009, p. 4) suggests that quantitative research method suits well for relationship studies. The purpose of the study was to examine relationship among different types of curricula. Therefore, quantitative approach was suitable for the study. Moreover, major portion of study was concerned with the analysis of content and the basis of a content analysis is quantification (Sommer & Sommer, 1997, p. 170). Additionally, the earlier studies conducted on curriculum (e.g. Akhtar (2004); Faize, 2011; Kanwal, 2001; Akhtar (2004); Rehman, 2004) did not give a quantitative measure of level of congruence among different types of curriculum. On the other hand, recent curriculum alignment measurement models (e.g. Webb's alignment model, the Surveys of Enacted Curriculum [SEC] model, and the Achieve model) measure alignment level among different types of curriculum quantitatively. Present study analysed the alignment level between different types of curriculum with respect to students learning outcomes [SLO]. Therefore, quantitative research method was employed to achieve the objectives of study.

3.2. Population

Population may consist of persons, objects, items, organizations, events, etc. (Gay, Mills, & Airasian, 2009; Ross, 2005; Yount, 2006). A well defined population is essential for research in education (Ross, 2005). The study aimed at determining alignment level of supported, taught, and assessed curricula with the written curriculum at secondary level in Punjab. Secondary/Higher Secondary Schools in Punjab, Biology teachers, Biology–IX & X textbooks, Biology-IX & X question papers (for Year 2013-2014) administered by BISEs in Punjab, and National Curriculum 2006 (Biology-IX & X) formed the population of study . Description and size of all the identified units of population are given in Table 3.1.

Table 3.1

Units of Population

Sr. No.	Description of Population Units	Population Size	Required for type of Curriculum
1	Secondary/Higher Secondary Schools	6563	Supported
2	Biology teachers of these schools	8369	Taught
3	Biology–IX & X textbooks taught in these schools and developed by PTB Lahore.	2 Text books	Supported
4	Biology-IX & X question papers (for Year 2013-2014) administered by BISEs in Punjab	4 question papers of every BISE	Assessed
5	National Curriculum 2006 (Biology-IX & X)	01	Written

3.3. Sample of the Study

Various research groups including the social scientists in more than 50 countries have used "Creative Research Systems" since 1982 (Creative Research Systems, 2012a). Its free online software "The Survey system" was used for the calculation of sample size. With 95% confidence level and confidence interval of 5, the size of the sample for population of 6563 (schools) was 363 (Creative Research Systems, 2012b). This sample size was also consistent with the Gay's (2005, p. 125) suggested table of required representative sample for given population size. Gay, Mills, and Airasian (2009, p.133) propose that for a population greater than 5000 sample of 400 is enough. As there was a slight (37) difference between the calculated sample size by "The Survey System" and that proposed by Gay, Mills, and Airasian (ibid). Moreover, number of schools from every district could also be equally taken. Therefore, the sample of 400 schools was taken. As there were 436 teachers teaching

Biology to secondary classes in the sampled school, therefore, all these teachers in the sampled school were included in the sample.

Similarly, universal samples of (a) question papers for Biology-IX & X administered by BISEs, (b) Biology-IX &X textbooks, and (c) National Curriculum for Biology-IX &X were taken. Table 3.2 shows all the identified units of sample and the sample size.

Table 3.2

Description of Sample

Sr. No.	Sample Description	Data source for	Total	Sampled
1	Secondary/Higher Secondary Schools	Resources available	6563	400 (6.1%)
2	Teachers	Teachers	8369	436 (5.2%)
3	Biology-IX & X question papers administered by 3 BISEs for session 2013-2014	Question papers of Biology-IX & X	12	12 (100%)
4	Textbooks of Biology-IX & X textbooks developed by PTB	Textbooks of Biology-IX & X	2	2 (100%)
5	National Curriculum 2006 (Biology-IX & X)	National Curriculum 2006 (Biology-IX& X)	1	1(100%)

3.4. Sampling Techniques

Selecting a sample that closely represents the population as well as avoiding sampling error and bias is crucial for valid and reliable findings. Every sampling technique has advantages and shortcomings. Keeping in view the research questions and the nature of population, single sampling technique was not adequate. Multi-stage sampling yields comprehensive samples by employing different techniques (Teddlie & Yu, 2007). Therefore, multi-stage sampling was used to select the sample. The sampling techniques employed are shown in Table3.3.

Table 3.3

Sample Selection Techniques employed

Sr. No.	Sample Description	Sampling Technique Employed
1	Secondary/Higher Secondary Schools	Stratified random sampling
2	Teachers	Stratified random sampling
3	Biology-IX & X question papers administered by BISEs	Universal sampling
4	Textbooks of Biology-IX & X	Universal sampling
5	National Curriculum 2006 (Biology-IX & X)	Universal sampling

The first important step was the selection of criteria that ensures representation of population. Fortunately, the SED constantly monitors the schools in Punjab Province through Chief Minister's Monitoring Force [CMMF]. Based on the data collected through CMMF about schools, all the districts in Punjab are ranked monthly, quarterly, and annually (Punjab Education Sector Reforms Programme [PERSP], 2012[a]). Key indicators for evaluating the quality of public schools are (a) access, (b) governance, and (c) quality (PERSP, 2012[b]). Using these indicators the districts are ranked and placed under four categories given in Table 3.4.

Table 3.4

Categories for Ranking of Districts by SED

Category	Achievement of Target
1	90-100%
2	80-90%
3	70-80%
4	60-70%

(PERSP, 2012c)

The categorization based on these key indicators with their sub-indicators forms a suitable criterion for selection of varied and diverse sample. Therefore, each category in this ranking by SED for the academic year 2011-12 formed the cluster. One district from every cluster was selected by convenient sampling method. Convenient method was employed due to following reasons:

1. Geographical vastness of the districts
2. Need of frequent visits for observation and training of subjects

Stratified random sampling method ensures equal representation of relevant subgroups (Gay, 2005, p. 117). At the next stage, stratified random sampling method was employed to select 100 schools from everyone of the selected districts. All the teachers teaching Biology to secondary classes were included in the sample.

In the sampled schools, textbooks for Biology IX and X published by Punjab Textbook Board were being taught. So, these two books were included in the sample. The sampled schools were under the jurisdiction of three BISEs. Moreover, the data for the curriculum taught by the teachers were collected for the session 2013-2014. BISEs conducted examinations for the session 2013-2014 in March 2014 in two groups (morning and evening). Therefore, Biology-IX & X examinations 2014 conducted by these three boards were included in the sample.

3.5. Research Instruments

The SEC system "serve[s] as a practical research tool for collecting consistent, reliable data on math and science" as it is "objective method" which has "the potential to provide education systems with dependable, comparable data to inform program evaluation and instructional improvement efforts" (Blank, 2002, p. 87). Additionally the SEC system employs tools which are "powerful descriptions of content emphases and the degree of overlap in content between instruction, assessments, and content standards" (Porter, 2002, p.8). Therefore, SEC content analysis protocol was employed for the analysis of written curriculum and the textbooks and SEC protocol was used for collecting data from the teachers about the taught curriculum.

About the reports from teachers about the taught curriculum, some educationists have raised observations. Important among these are:

(a) Teachers may falsely report

(b) Teachers may mistakenly report that they are teaching some content and as a matter of fact they may not

(c) Teachers may be unclear about the terms used in the protocols

(Cohon, 1990; Scherpenzeel & Saris, 1997)

However, these may be apprehensions which have been refuted by other studies (e.g. Porter, Kirst, Osthoff, Smithson, & Schneider, 1993). Teachers may falsely report if data are used for accountability of teachers or when one is asking about the quality of teaching. Various studies confirm that if one asks about the quantity of teaching the data given by the teacher himself is valid (Herman, Klein, &

Abedi, 2000; McCaffrey, et al., 2001). In this regard Porter, Kirst, Osthoff, Smithson, and Schneider (1993) studied correlations between teachers self-reports and observations of lessons by the researchers and found that both were highly correlated (correlations ranged from 0.7 to 0.8). Moreover, "observations are even more expensive and intrusive" and only the surveys (Teachers' self-reports) are the feasible tools which "produce surprisingly valid data when the focus is on quantity" (Porter, 2002, p. 9).

For collecting data about the available materials for conducting practical work, an observational checklist was developed. The research instruments employed to gather data for getting the answers of the research questions of the study are shown in Table 3.5.

Table 3.5

Description of research instruments

Sr. No.	Instrument	Data Source
1	Observation check list	Schools [Appendix F]
2	Surveys of enacted curriculum protocol	Teachers [Appendix C]
3	Content analysis protocol	Textbooks [Appendix D]
		Question papers [Appendix E]
		Curriculum [Appendix F]

3.6. Development of Research Instruments

3.6.1 Observation Checklist

Observation provides reliable data. In order to find out available materials for practical work, an observation check list was prepared. In the written curriculum a list of required material for the practical work was given (GOP, 2006a, pp. 78-81), all the items from this list were included in the observation checklist.

3.6.2 Surveys of Enacted Curriculum Protocol and Content Analysis Protocol

Using a uniform language across written, supported, taught and assessed curricula not only warrants a coherent depth and specificity but also helps in making alignment indices (Porter, 2002, pp. 3-4). Surveys of Enacted Curriculum [SEC] model uses the uniform language for analysis of different types of curriculum. Therefore, a common language framework was used for developing the surveys of enacted curriculum protocols for written curriculum, textbooks, and taught curriculum. As the study aimed at finding how much taught, supported and assessed curricula are aligned with the written curriculum, so, the written curriculum played a pivotal role in shaping the framework of the protocols.

The first task, in this regard, was to decide the topics. In the written curriculum, major themes for Grades IX & X were divided into three categories viz. Sections (six), chapters (18), and topics (76). Usually, alignment analysis is done at two levels namely (a) coarse grain level and (b) fine grain level. This study also analyzed the alignment at two levels (a) coarse grain level (sections level given in the written curriculum, (b) fine gain level (topics level given in the written curriculum).

The SEC protocol consists of two-dimensional matrix comprising of (a) level of coverage and (b) cognitive demand. The category "level of coverage" consists of the time spent on each topic. These categories can be extended and improved. Porter himself admits that "current versions of content languages can be improved" particularly in identifying topics as well as number and types of cognitive demand category (Porter, 2002, p. 12). Moreover, to meet the requirements of the present study, this category of cognitive demand was modified as under.

In the protocol for this study, the category "level of coverage" was employed without any change. In the standardized SEC protocol the category "cognitive demand" has been further divided in to five subcategories which are:

(a) Memorize

(b) Perform procedures

(c) Communicate understanding

(d) Solve non-routine problems, and

(e) Conjecture/generalize/prove.

However, in the written curriculum, the students learning outcomes have been subdivided into three parts viz. (i) understanding (knowledge, comprehension, application, analysis, synthesis, and evaluation in accordance with the Bloom's classification of objectives (Bloom, 1956), (ii) skills, and (iii) STS connections. The subcategories in the SEC protocol were replaced by following subcategories in accordance with the written curriculum:

(a) Knowledge

(b) Comprehension

(c) Application

(d) Higher order cognitive levels

(e) Skills, and

(f) STS connection (Bloom, 1956)

3.7. Selection of Panellists and their Training

SEC, like other alignment measurement methods, employs qualified and subject relevant experts to analyse the related material (Davis-Becker & Buckendahl, 2013; Porter, Smithson, Blank & Zeidner, 2007; Porter, 2002). These panellists, should:

- Be well-known with the specific content (may be teachers or curriculum specialists)
- Be familiar with the capabilities and knowledge level of the learners (the intended population)
- Have proper working experience with the learners
- Be well acquainted with the curriculum, and
- Have not been involved in the development of curriculum (as they know the expected alignment) (Davis-Becker & Buckendahl, 2013; La Marca, Redfield, Winter, Bailey, & Despriet, 2000).

While selecting the subject matter experts (panellists), the above guidelines were duly considered. For example, these panellists had good knowledge of the content (as they possessed Master level degree in relevant subject), and curriculum (as they possessed Master level degree in Education). Moreover, they were familiar with the abilities and knowledge level of learners and working experience (more than ten years experience). The description of the panellist is given in Table 3.6.

Table 3.6

The Description of panellists

Panellist	Designation	Qualification		Experience (Years)		
		Academic	Professional	Teaching	Paper Setter	Examiner
A	Senior Subject Specialist	M.Sc. (Zoology)	M.Ed.	14	3 (2002-2005)	7
B	Senior Subject Specialist	M.Sc. (Botany)	M.Ed.	12	3 (2004-2007)	7

The panellists were informed about the objectives, research questions, and methodology of the study. To provide an opportunity for clarification of any doubt about the written curriculum, a team of two curriculum developers was arranged. These curriculum developers answered various questions regarding curriculum.

3.8. Validity and Reliability

Research instruments of this study were to collect data based on facts and not on "constructs". Moreover, the study aimed at finding the alignment level of taught, supported, and assessed curricula with the written curriculum. Therefore, written curriculum served as the basis for other types of curriculum. In case of observation checklist, all the materials mentioned in the written curriculum were included in it. Similarly, all the topics as well as the SLO were included in the SEC protocols and the content analysis protocol. Furthermore, SEC protocol and the content analysis protocol are instruments which are being extensively used. Still, several measures were undertaken to ensure the validity and reliability of the instruments; the major ones are as under:

(i) Seeking experts' opinion

(ii) Pilot-testing

(iii) Applying Davis-Becker and Buckendahl's model for evaluating the curriculum-alignment studies

(iv) Ensuring high inter-raters correlation

3.8.1 Experts' Opinion

Opinions about improvement of the instruments of study were sought from two experts who had experience of teaching, authorship of books, assessment, and curriculum development. The panellists were also asked to give their opinion about the methodology of the study. Both the experts and the panellists advised modification in subcategories of cognitive demand. The research instruments were modified in the light of these recommendations.

3.8.2 Pilot-Testing

The research tools were pilot-tested to ensure validity. The observation checklist was pilot-tested in 20 schools and the SEC protocol was pilot-tested on twenty teachers (five teachers from every category). The content analysis protocols were pilot-tested on National Curriculum -Biology (Grade IX &X), Biology Textbooks (IX & X) and Examination Papers of 2006). It is to be noted that only two chapters from each Grade were pilot tested. This not only helped in improving the research tools, it also helped to train the panelists to practice the specific methodology of the study.

3.8.3. Applying Davis-Becker and Buckendahl's Model for Evaluating the Curriculum-alignment Studies

Davis-Becker and Buckendahl (2013) have proposed a model to systematically evaluate the validity of curriculum-alignment studies. The proposed framework helps the researchers of alignment studies in evaluating "each component in the design of the alignment study as well as in the reporting of the results" (ibid, p. 32). They have discussed particularly the procedural, internal, and external threats to validity. These possible threats to validity were duly considered for the present study and possible measures to ensure the validity were taken as are given in Table 3.7.

Table 3.7

Application of Alignment Studies' Evaluation Framework

Dimension	Area	Validity Evidence	Threats to Validity	Measures Taken to Minimize Threats
Procedural	Panellists	Qualifications and familiarity with content domain	Unfamiliarity with the (a) content to be analysed (b) knowledge and skills of the examinee population (c) improper working experience with the learners	Well qualified and experienced teachers were chosen as panellists who were familiar with the content as well as the students and job of sampled teachers.
		Independence	Have been involved in the development of curriculum (as they know the expected alignment) or item writing for examinations	They were completely independent as they were not part of process of current curriculum development as well as process of conducting examinations.
	Method	Content match and cognitive complexity	No or little consideration of content and cognitive complexity in alignment methodology	All the topics were included and appropriate cognitive complexity was incorporated
	Process	Training of panellists	Training of the panellists is inconsistent with the methodology.	The panellists were properly informed about the objectives, research questions, and methodology of the study. They

Dimension	Area	Validity Evidence	Threats to Validity	Measures Taken to Minimize Threats
				were also provided opportunity to clarify concepts by meeting a team of two curriculum developers.
		Practice of alignment process	The panellists have had no opportunity to practice the content analysis process.	The panellists were provided opportunity to sufficiently practice the particular content analysis methodology of the study.
		Panellists' evaluation of process	The panellist may be dissatisfied with the methodology.	The panellists' feedback was sought and incorporated in the methodology. Moreover, they were also satisfied with the results of pilot study.
Internal	Panellists' agreement	Analysis of panellists' indepen-dent ratings	The panellists may not be provided opportunity to independently anlyse the content.	The panellists were provided opportunity to independently analyse the content.
		Inter-panellists' agreement estimate	Agreement among the panellists may not be evaluated.	The correlation between the panellists was calculated and it was 0.95.
		Panellists' evaluation of the final results	There exists significant disagreement within the panel.	There was agreement between the panel members at all levels.
External		Individual panellist's results	Individual panellist's results may not be correlated with those of others.	The results of individual panellist were highly correlated with those of other.
Utility		Interpreta-tion of results	Interpretation of results does not point out the "not align" elements.	The data were interpreted in such way that it pointed out the not-aligned elements.
			The results may be over-interpreted.	The results were interpreted objectively on the basis of data.
		Communi-cation of results	The results of the study may not be properly communicated to the stakeholders.	The results of the study will be communicated to the participants and all the stake holders after the completion of the study.

According to Gay, Mills, and Airasian (2009, p.138) "a valid test is always reliable". So, if the instruments' validity confirmed by Davis-Becker and Buckendahl's (2013) model also establishes their reliability.

3.8.4. Inter-raters Correlation

The panellists were given the opportunity to independently analyse the content. They were given same chapter of each of the Biology IX & X textbooks, concerning part of the National Curriculum 2000 for Biology IX & X as well as Biology IX & X examination papers (Annual 2004). The correlation between the two was 0.89. Although it was sufficient correlation, yet to achieve maximum consistency within the panel, the panellists then discussed the disagreements with each other and with their trainers. The panellists then repeated the process taking another chapter of each of the Biology IX & X textbooks, concerning part of the National Curriculum 2000 for Biology IX & X as well as Biology IX & X examination papers (Supplementary 2004). Moreover, using SPSS statistics17.0 and taking four clusters of teachers as variable, the value of Cronbach's Alpha was calculated. It was 0.871 [Appendix- H], which reflected a good level of internal consistency.

3.9. Finalization of Research Instruments

The suggestions by the experts, panellists, and the pilot-study were incorporated to refine the instruments. The major changes made in the instruments were changing the sub categories of cognitive demand and reducing the number of topics (topics having three or less class periods were merged with other relevant topics). Finally, SEC protocol consisted of "Topics" (total 40) with two categories

(a) "Level of coverage" (given in the left column of topic)

(b) "Cognitive demand" (given in the right columns of topic)

The category cognitive demand was further divided into four subdivisions namely (a) Remember, (b) Understand, (c) Skills, (d) STS connection. The subcategory of "remember" was same as the category of "Knowledge" in Bloom's taxonomy of learning objectives (cognitive level) and the subcategory "understand" consisted of all the other categories (comprehension, application, analysis, synthesis, evaluation) of Bloom's taxonomy of learning objectives (cognitive level) (Bloom, 1956).

For the written curriculum and the textbooks, it was the number and nature of SLOs which were counted and put in the relevant subcategory of cognitive demand. For the taught curriculum, the subjects were to indicate the relative emphasis they gave to everyone of the subcategory of cognitive demand. For the question papers, every item was analyzed and marks for every item were entered in the relevant subcategory of cognitive demand.

3.10. Data Collection

The sample of the study consisted of schools from the four districts of Punjab. It was not feasible for the researcher alone to personally visit all the sampled school due to geographical vastness of the sampled districts. Moreover, due to low response rate of mailed tools, sending the SEC protocol to teachers through mail was not suitable. Therefore, proper help was taken from two friends (teachers holding master degree in Education and had more than ten years experience of teaching Biology to secondary classes). These were properly trained about objectives of the study, methodology, and tools of the study. The data from two districts were got with the help of these friends.

The academic session in Punjab started from first April 2013 and continued till 31st March 2014. Annual examinations were held during March 2014. From first June 2013 to 14th August 2013 Schools were closed for summer vacations. The data collection process from the schools and teachers started from April 2013.

First of all approval was obtained from the concerned District Education Officer (SE) to visit schools and teachers for data collection. Then the heads of the sampled schools were contacted to get approval and support for getting data from the concerned sections. The teachers were requested for giving time for surveys of enacted curriculum protocol by explaining to them the significance of the study, promising them to send them the findings of the study and assuring them of their anonymity as well as the use of data only for research purposes. The researcher's experience as teacher of secondary classes and his links with different teachers' associations were also helpful in convincing the heads and the teachers to cooperate in data collection. All these efforts enabled the researcher to collect data from 400 teachers (return rate 91%). However, it was ensured that data were obtained from teacher of every sampled school, and the nine percent remaining teachers were from the schools where more than one Biology teachers were working.

Porter (2002, p. 9) recommends that, for large samples and extended period, the end-of-year surveys are "easy to quantify, replicable, and inexpensive". Therefore, it was decided to take the data from the teachers at the end of academic year. However, all the sampled schools were visited before summer vacation. During this session, laboratory of the school was visited and observation checklist was also filled up. Moreover, the sampled teachers were informed about what sort of data needed from them. They were also trained about how to fill the SEC protocol. The subjects were given hard copy of sample of SEC protocol. Every subject was trained about details of SEC protocol, particularly its category of cognitive demand, as well as how to fill up the protocol. The purpose was to motivate the subjects and prepare them mentally that they would report about their taught content at the end of the year. Fortunately, during the summer vacations of 2013, the Punjab School Education Department organized a four weeks training workshop for all the Biology teachers. It was organized at district level. Most of the subjects attended this training. It was a good opportunity for the researcher. The researcher personally visited these training venues and was able to get time from the concerned District Training and Support Centre. Here, the subjects were again guided about objectives of the study and provided an opportunity to clear their doubts, if any, about the SEC protocol. Biology IX & X theory question papers consisted each of 112 marks their distribution is given in Table 3.8.

Table 3.8

Distribution of Marks in Question Papers (Theory) for Biology IX-X

Question Type	**No. of items**	**Marks per Item**	**Total Marks**
Multiple Choice	12	01	12
Short Question	25	02	50
Long question	5 (with two parts)	07 (part A=4,Part B=3)	35
Questions Relating to Practicals	3 (with two parts)	05 (part A=3,Part B=2)	15
	Total		**112**

In addition to the theory question paper there was also a practical paper with 20 marks with two questions of seven marks each and third question of viva voce (three marks) and fourth of practical notebooks (three marks each). One question was from Grade IX and other question was from Grade X. As viva voce questions were asked relating to practicals in the question paper and there were two notebooks (one for Grade IX and one for Grade X), therefore, these marks were equally distributed between question paper for Grade IX and that of Grade X. In this way question paper of each Grade consisted of questions of total marks 122.

The panellists analyzed the written curriculum, the textbooks, and the examination papers by using the content analysis protocol for curriculum. The learning outcomes/items falling in more than one category of cognitive demands were, as in SEC method and also recommended by Herman, Webb, and Zuniga (2007), were equally divided among those categories.

3.11 Data Analysis

The data obtained through research instruments were organized. The data showed that teachers could be grouped into following four categories with respect to their educational qualifications:

- M.Phil/MS or MSc/BSc Honours (Botany/Zoology)
- BSc Biology and B.Ed.
- BSc (Biology or other than Biology subjects)
- MSc or BSc and M.Ed.

Therefore, teachers from every district were divided into these four groups.

The data in every subcategory of "cognitive demand" were converted to percentage with respect to total number of student learning outcomes for every topic. There were 19 topics for Grade IX and 21 topics for Grade X. Then the percentages in every cell for Grade IX and Grade X were divided by 1900 and 2100 respectively. In this way a 4x19 matrix for Grade IX and 4x21 matrix for Grade X were obtained and the sum of all the elements of every matrix was 1.00. Thus, matrices of same order (same number of columns and rows) were obtained for each Grade as well as written curriculum, taught curriculum, assessed curriculum, and textbooks. These matrices are given in the Appendix G. This made possible to compare and contrast in a meaningful way the different types of curriculum. It also enabled to find out quantitative measure of degree of alignment.

For determining the extent of alignment quantitatively, a mathematical procedure of using cell by cell comparison of data of two sets was applied. Porter (2002) introduced formula of alignment index [AI], this formula was used for developing the alignment index.

$$\text{Alignment Index} = 1 - \frac{\Sigma|x-y|}{2} \qquad \text{(Porter, 2002)}$$

Here, x stands for value in one matrix whereas y stands for cell value in other matrix. Simple Microsoft Excel was used for the application of this formula.

Following example would help to illustrate the method. In Figure 3.2, let matrix A shows the ratio of SLOs in written curriculum and matrix B shows the ratio of SLOs in textbook. Matrix C shows the sum of cell by cell intersection or ratio difference (RD).

A

0.2	**0.1**	**0**	**0.3**
0.2	**0**	**0**	**0.2**
0.1	**0.1**	**0**	**0.2**

B

0.1	**0.1**	**.2**	**0.3**
0.1	**0**	**0**	**0.1**
0.1	**0.1**	**0.1**	**0.2**

C

Subtotal	**Ratio Difference (RD)**			
	0.1	0	0.2	0
	0.1	0	0	0.1
	0	0	0.1	0
Total	**0.2**	**0**	**0.3**	**0.1**

Total Ratio Difference=0.6

Figure 3.2. Example for calculating Alignment Index

Alignment Index (AI) = 1-0.6/2=0.7

The value of alignment index ranges from 0 to 1, where one indicates complete alignment and 0 represents complete misalignment. However, for the interpretation of the findings of this study following criteria was adopted:

Table 3.9

Interpretation of Alignment index value

Value of Alignment index	**Interpretation**
0.9-1.00	Good alignment
0.8-0.9	Significant alignment
0.7-0.8	Considerable alignment
0.6-0.7	Considerable misalignment
0.5-0.6	Significant misalignment
Less than 0.5	Critical misalignment

(Fonthal, 2004; Fulmer, 2011; Ndlovu & Mji, 2012)

It is important to note that there was difference in ratio of SLOs with respect to subcategories of cognitive demand in the written curriculum. Therefore, ratio difference of every subcategory of cognitive demand was interpreted with reference to its ratio to total number of SLOs. These values and their interpretation is given in Appendix B.

To find out the areas of (mis)alignment in detail, the percentages of every subcategory of cognitive demand were compared and the results were shown in the form of bar graphs. Moreover, the results of the category of "level of coverage" (which consisted of number of class-periods) were compared through percentages and presented in the form of graphs.

To sum up, the data were interpreted through computing:

1. Alignment Index (to find alignment level as a whole i.e. book/question paper level).
2. Ratio difference (to find alignment at section/topic and subcategory of cognitive demand level).
3. SLO Percentages (to find alignment at section/topic level).

3.12 Chapter Overview

This chapter explained the methodology adopted for achieving the objectives of the study. Instruments of study for measuring the alignment level among different types of curricula have been described. These instruments were observation check list, survey of enacted curriculum protocol for teachers, and content analysis protocol for textbooks and question papers. For determining the extent of alignment quantitatively, matrices of same order were developed, and a mathematical procedure of using cell by cell comparison of data of the two sets was applied. The following chapter presents the data in the form of tables and graphs as well as analysis and discussion of the data.

CHAPTER 4

DATA COLLECTION AND DATA ANALYSIS

The study was conducted to determine the alignment level of the taught, supported, tested curricula with the written curriculum. To achieve the objective of the study, following tools were used for collecting data:

I. Content analysis protocol.

II. Surveys of enacted curriculum protocol.

III. Observation check list.

The data collected through these research instruments were arranged and the results were presented in the form of tables and graphs. The main concern of this chapter is presentation, analysis and interpretation of the data collected for the study.

Table 4.1

Alignment of Written Curriculum with Textbooks: Coarse Grain Level

Section Number	Ratio Difference with respect to				
	Remember12	**Understand12**	**Skills12**	**STS12**	**Subtotal**
A	0.062	0.013	0.024	0.026	**0.125**
B	**0.035**	0.019	0.004	0.011	0.069
C	0.028	0.002	0.001	0.024	0.056
D	0.023	0.005	0.006	0.034	0.068
E	0.056	0.029	0.008	0.034	**0.127**
F	0.052	0.024	0.002	0.029	**0.107**
Total	**0.256**	**0.093**	**0.045**	**0.158**	**0.552**
		Alignment Index			**0.72**

Note: 12= Between Written Curriculum and Textbooks, STS=STS Connection

Table 4.1 shows alignment of written curriculum with textbooks at coarse grain level. It shows that the alignment index between written curriculum and textbooks at Coarse Grain level is 0.72 which reflects a considerable level of alignment. However, this alignment is not equally distributed among all the sections or subcategories. For example, the sections A, E, and F are considerably misaligned as the sums of ratio difference of subcategories are 0.125, 0.127, and 0.552 respectively. Similarly, on the whole subcategory STS Connection is critically misaligned (sum of ratio difference is 0.158) and subcategory Remember is considerably misaligned (sum of ratio difference is 0.256). Moreover, except that of section B, all the sections are critically misaligned with respect to STS connection subcategory. Furthermore, sections E and F are considerably misaligned with respect to subcategories Understand (ratio differences are 0.029 and 0.024) and Remember (ration difference 0.056 and 0.052).

The misalignment in sections A, E and F is because textbook provides more content with respect to Remember category (Fig. 4.1), less content with respect to Understand category (Fig. 4.2) and no content with respect to STS Connection category (Fig. 4.4). Therefore, less content for Remember category, more content for Understand category and content for STS Connection category is required for good alignment between the content of textbooks and curriculum.

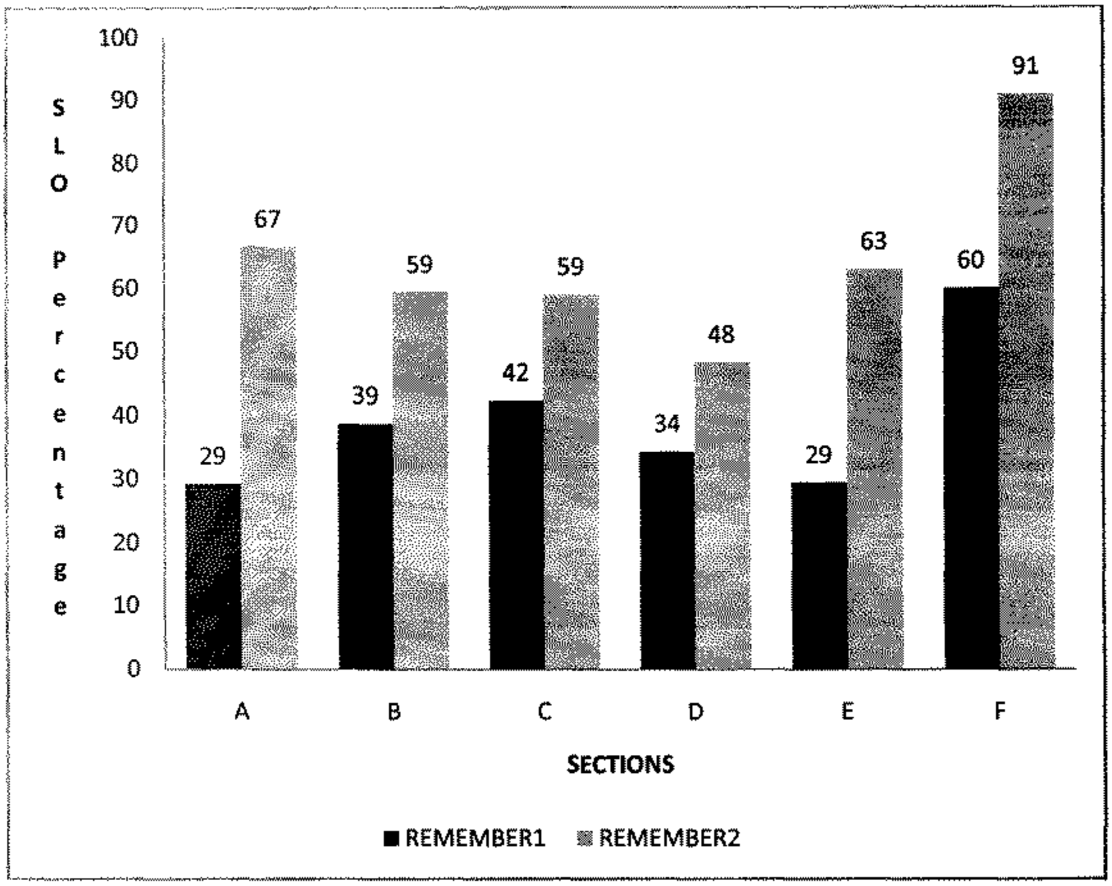

Figure 4.1. Comparison of Written Curriculum and Textbooks: Coarse Grain Level-subcategory Remember *(1=Written Curriculum, 2= Textbooks)*

Figure 4.1 compares written curriculum and textbooks with respect to cognitive demand's subcategory remember at coarse grain level. It shows that, at coarse grain level, the textbooks provide more content with respect to Remember subcategory than that of suggested in written curriculum. The textbooks' greater emphasis on Remember subcategory is more evident in the sections A, E, and F as difference here is 38%, 34%, and 31% respectively. On the other hand this difference of emphasis is less in the sections B, C, and D where difference is 20%, 17%, and 14 respectively.

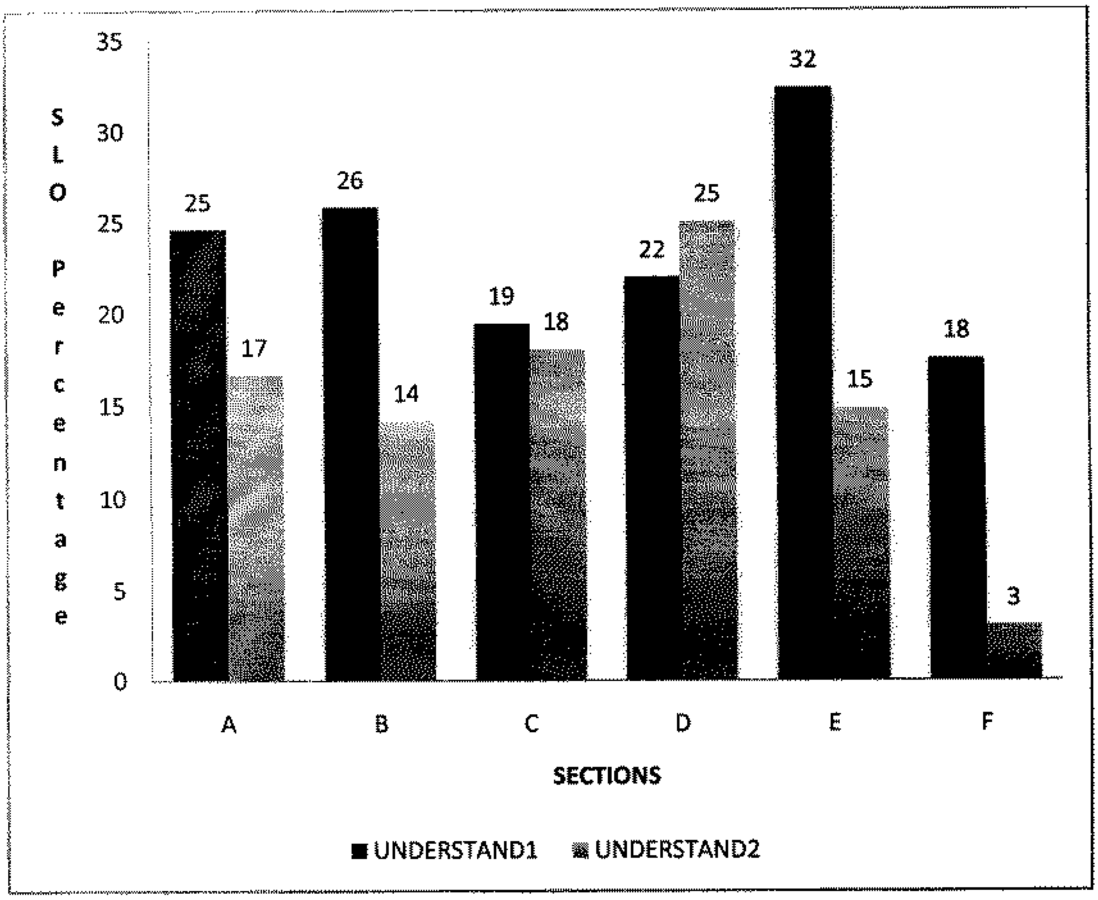

Figure 4.2. Comparison of Written Curriculum and Textbooks: Coarse Grain level-subcategory Understand *(1=Written Curriculum, 2= Textbooks)*

Figure 4.2 compares written curriculum and textbooks with respect to cognitive demand's subcategory understand at coarse grain level. It shows that the textbooks give insufficient content with respect to understand subcategory of cognitive demand at coarse grain level. This deficiency is more evident in the Sections B, E, and F where it is 12%, 17%, and 15% respectively. However, Sections C and D of the textbooks are more aligned with respect to understand subcategory because Section C of the textbooks give 1% less and D 3% greater emphasis than that of written curriculum.

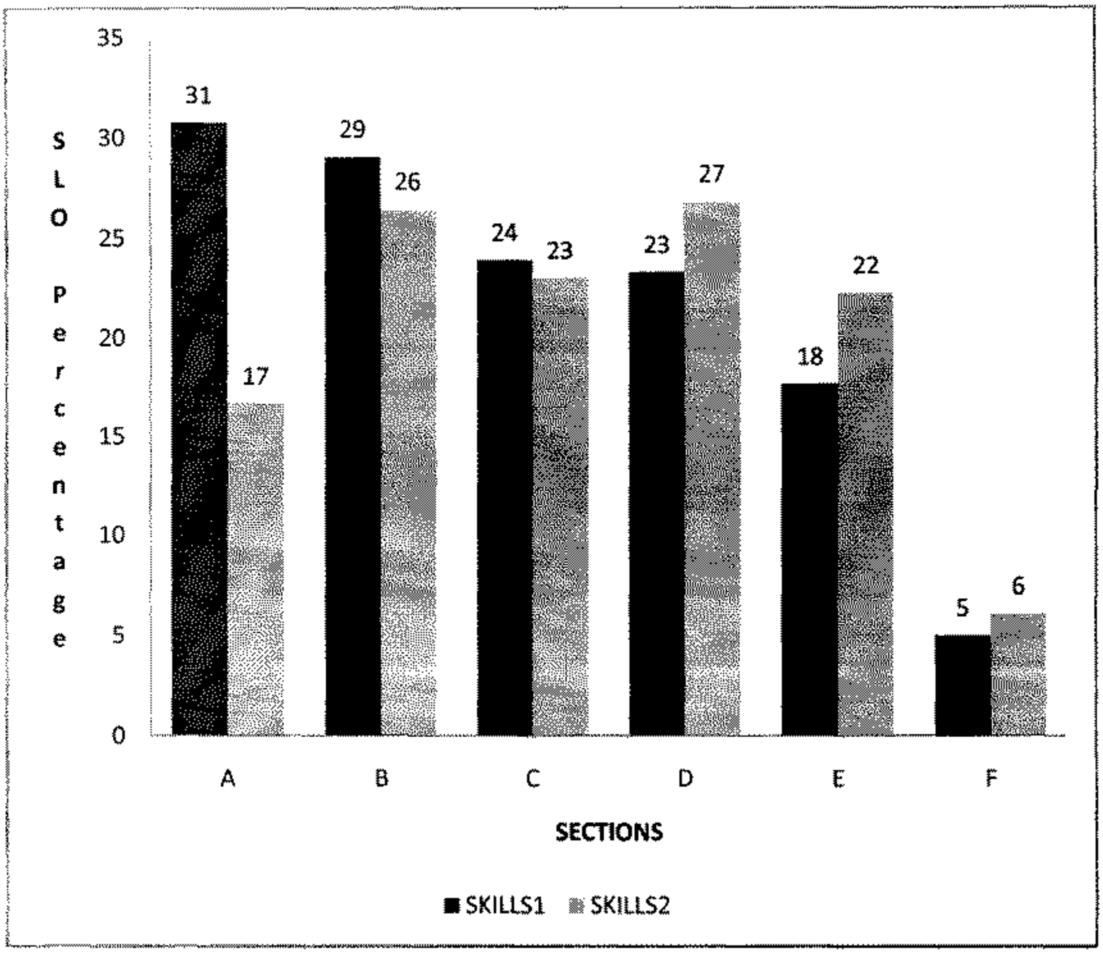

Figure 4.3. Comparison of Written Curriculum and Textbooks: Coarse Grain level-subcategory Skills *(1=Written Curriculum, 2= Textbook)*

Figure 4.3 compares written curriculum and textbooks with respect to cognitive demand's subcategory skills at coarse grain level. It shows that, at coarse grain level, there is not a single section in which written curriculum and the textbooks are completely aligned with respect to skills level of cognitive demand. However, this misalignment is more evident in except the Section A (difference of SLO percentage is 14%). The other sections are comparatively less misaligned (difference of SLO percentage ranges from 1% to 4%).

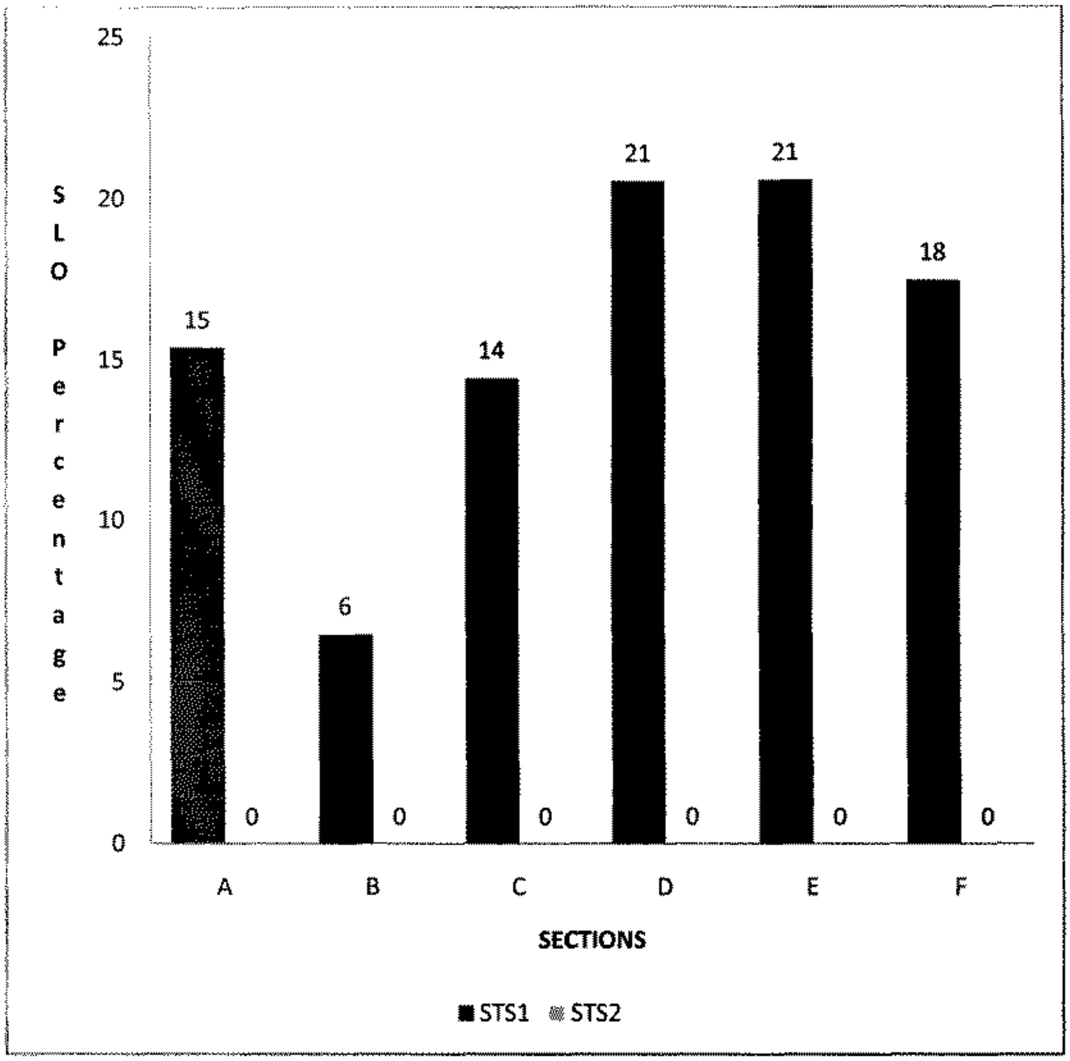

Figure 4.4. Comparison of Written Curriculum and Textbooks: Coarse Grain level-subcategory STS Connection (*1=Written Curriculum, 2= Textbook)*

Figure 4.4 compares written curriculum and textbooks with respect to cognitive demand's subcategory STS Connection at coarse grain level. It clearly reflects that, in contrast to written curriculum's requirement, the textbooks have not provided any content with respect to STS Connection at coarse grain level.

Table 4.2

Alignment of Written Curriculum with Textbook-Grade IX: Fine Grain Level

Topic Number	**Remember12**	**Understand12**	**Skills12**	**STS12**	**Subtotal**
	Ratio Difference with respect to				
1a	0.020	0.008	0.000	0.012	**0.040**
1b	0.010	0.006	0.005	0.000	0.021
2a	0.035	0.001	0.036	0.000	**0.073**
3a	0.021	0.007	0.001	0.013	**0.043**
3b	0.007	0.005	0.001	0.011	0.023
4a	0.025	0.007	0.002	0.016	**0.049**
4b	0.017	0.017	0.000	0.000	**0.034**
4c	0.018	0.005	0.009	0.005	**0.037**
4d	0.016	0.002	0.001	0.014	**0.033**
5a	0.007	0.007	0.000	0.000	0.014
5b	0.010	0.007	0.001	0.004	0.021
6a	0.002	0.003	0.001	0.000	0.006
6b	0.021	0.021	0.000	0.000	**0.042**
7a	0.004	0.001	0.005	0.000	0.010
7b	0.000	0.000	0.000	0.000	0.000
8a	0.011	0.002	0.003	0.007	0.023
8b	0.006	0.010	0.000	0.004	0.020
9a	0.014	0.014	0.000	0.000	0.028
9b	0.004	0.003	0.001	0.006	0.014
Total	**0.249**	**0.125**	**0.065**	**0.091**	**0.529**
	Alignment Index				**0.74**

Note: 12= Between Written Curriculum and Textbooks, STS=STS Connection

Table 4.2 shows alignment of written curriculum with textbook-Grade IX at fine grain level. It shows that the alignment index between written curriculum and textbook –Grade IX is 0.74 which reflects a considerable alignment level. However, many topics and subcategories are misaligned. For example, subcategory STS connection (sum of ratio difference is 0.091) and topic 2a (sum of ratio difference is 0.073) are misaligned to the critical level. Similarly, topics 3a and 4a (sum of ratio difference ranges from 0.043 to 0.049) are significantly misaligned, while the topics 1a, 4b, 4c, 4d, and 6b (ratio difference ranges from 0.033 to 0.042) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 2a and 4a are critically misaligned (ratio difference ranges from 0.025 to 0.035), the topics 1a, 3a, 4c and 6b are significantly misaligned (ratio difference ranges from 0.018 to 0.021), (b) with respect to Understand subcategory, the topics 4b, 6b, and 9a are critically misaligned (ratio difference ranges from 0.014 to 0.021), and (c) with respect to STS Connection subcategory, the topics 3a, 4a and 4d are critically misaligned (ratio difference ranges from 0.013 to 0.016), the topic 1a is significantly misaligned (ratio difference is 0.012).

The number of SLO relating to Understand category is one cause of this misalignment between written curriculum and textbook. The topics with greater number of SLO relating to Understand category are relatively more misaligned (Fig. 4.6). It indicates that textbook's content is limited to lower level category of cognitive demand (Fig. 4.5) at variance with written curriculum which demands more elaborate content for topics to achieve SLO of higher order level.

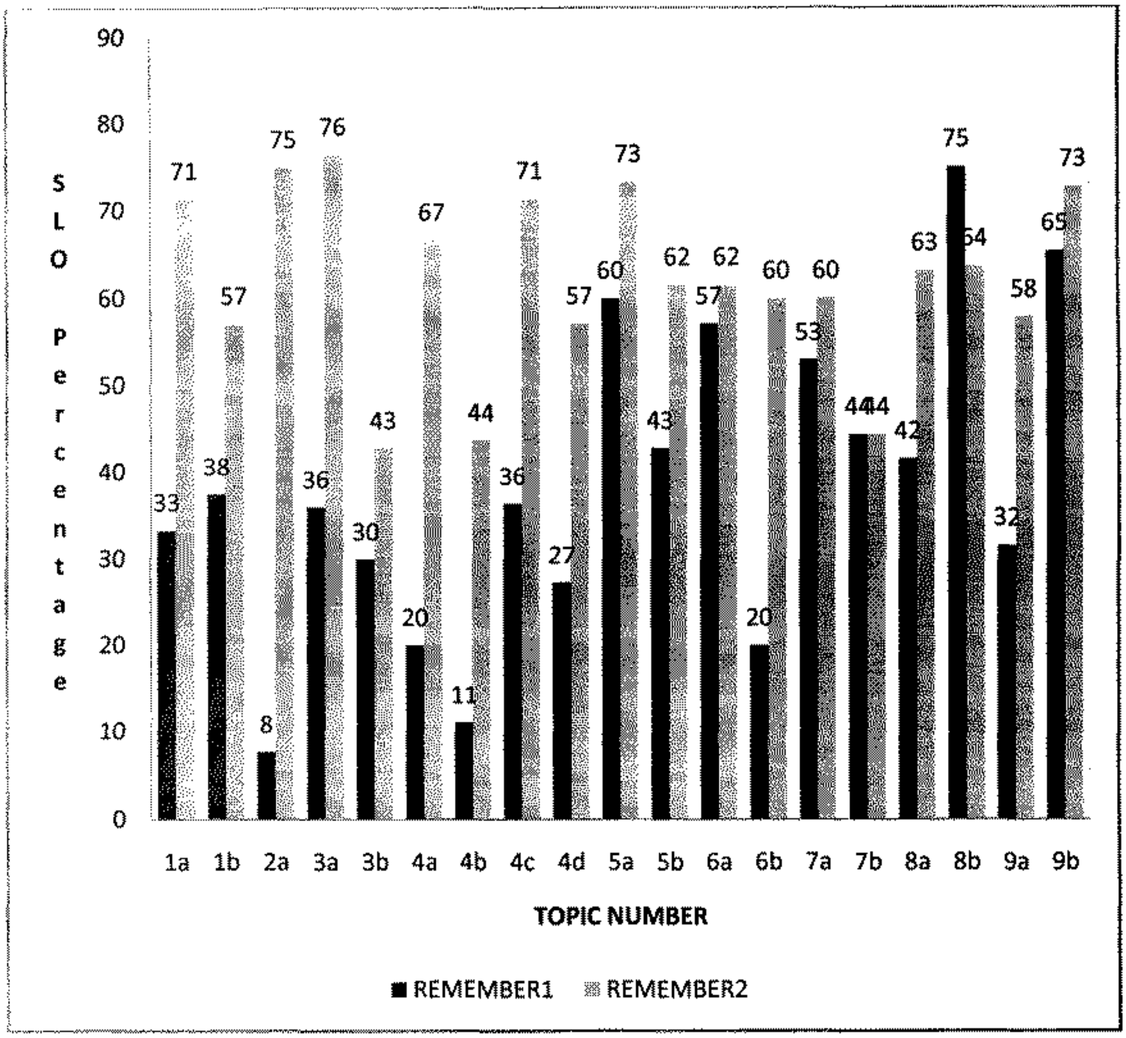

Figure 4.5. Comparison of Written Curriculum and Textbook-Grade IX: Fine Grain Level- Subcategory Remember *(1=Written Curriculum, 2= Textbook)*

Figure 4.5 compares written curriculum and textbook-Grade IX with respect to cognitive demand's subcategory remember at fine grain level. It shows that except the topic 7b, textbook-Grade IX provides much more content (the difference of SLO percentage ranges from 5% to 67%) than that of given in written curriculum with respect to Remember subcategory of cognitive demand. This gap can be particularly seen in the topics 2a, 3a, 4a, and 6b where the differences of SLO percentage are 67%, 40%, 47%, and 40% respectively.

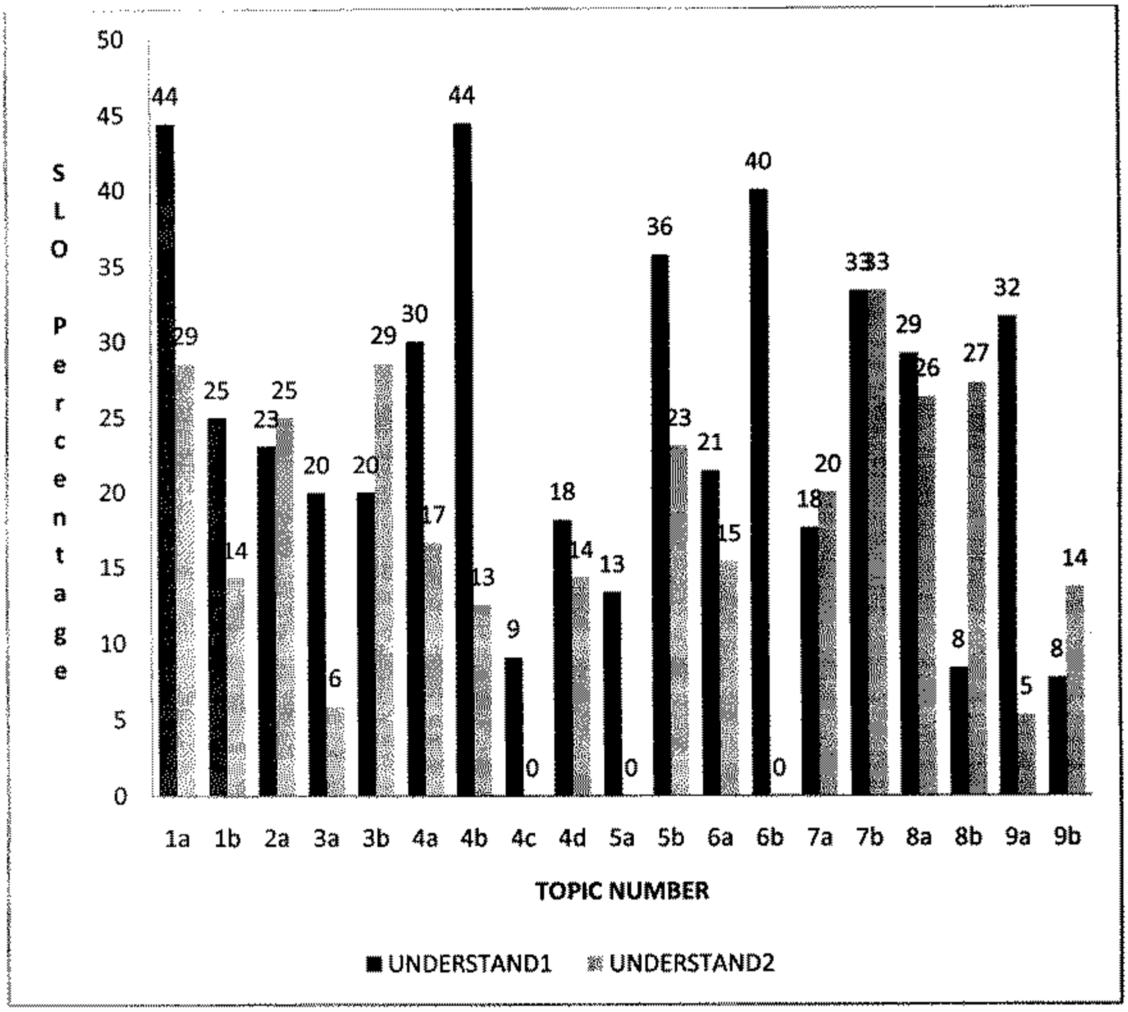

Figure 4.6. Comparison of Written Curriculum and Textbook-Grade IX: Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 2= Textbook)*

Figure 4.6 compares written curriculum and textbook-Grade IX with respect to cognitive demand's subcategory understand at fine grain level. It shows that, except the topic 7a, there is no topic in which the textbook-Grade IX and written curriculum are completely aligned with respect to Understand subcategory of cognitive demand (the difference of SLO percentage ranges from 2% to 40%). SLO percentage of most of the topics in textbooks is much less than that of given in written curriculum. This gap can be particularly seen in the topics 4b, 6b, and 9a where the differences of written curriculum and the textbook-Grade IX are 32%, 40%, and 26% respectively.

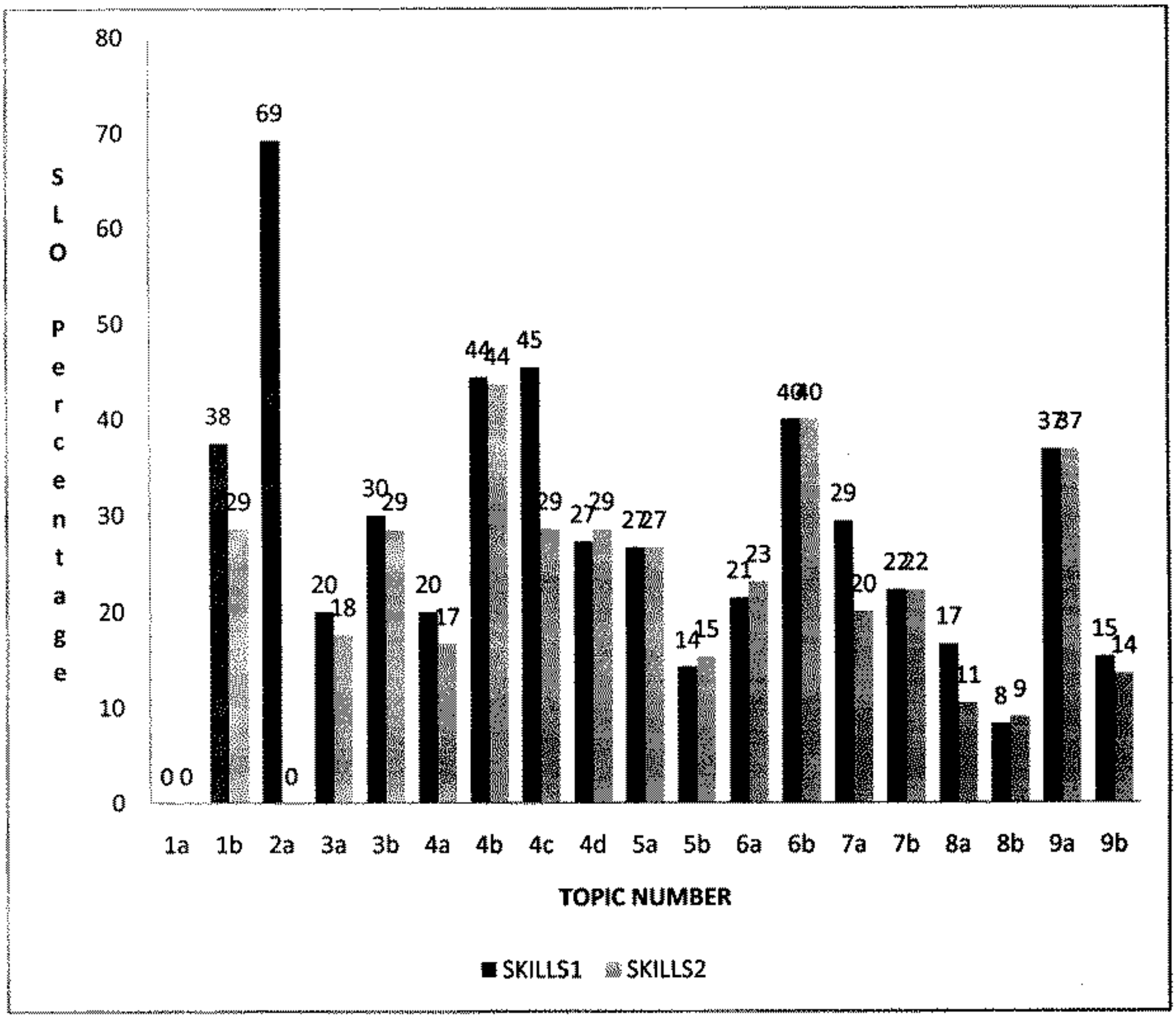

Figure 4.7. Comparison of Written Curriculum and Textbook-Grade IX: Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 2= Textbook)*

Figure 4.7 compares written curriculum and textbook-Grade IX with respect to cognitive demand's subcategory skills at fine grain level. It shows that topics 1a, 3b, 4b, 4d, 5a, 7b, 9a, and 9b of the textbook-Grade IX are significantly aligned (difference of SLO percentage ranges from 0% to 3%) with those of written curriculum. However, there is also a significant gap (difference of SLO percentage is 17% and 67% respectively) between the textbook and the written curriculum in topic numbers 2a and 7b.

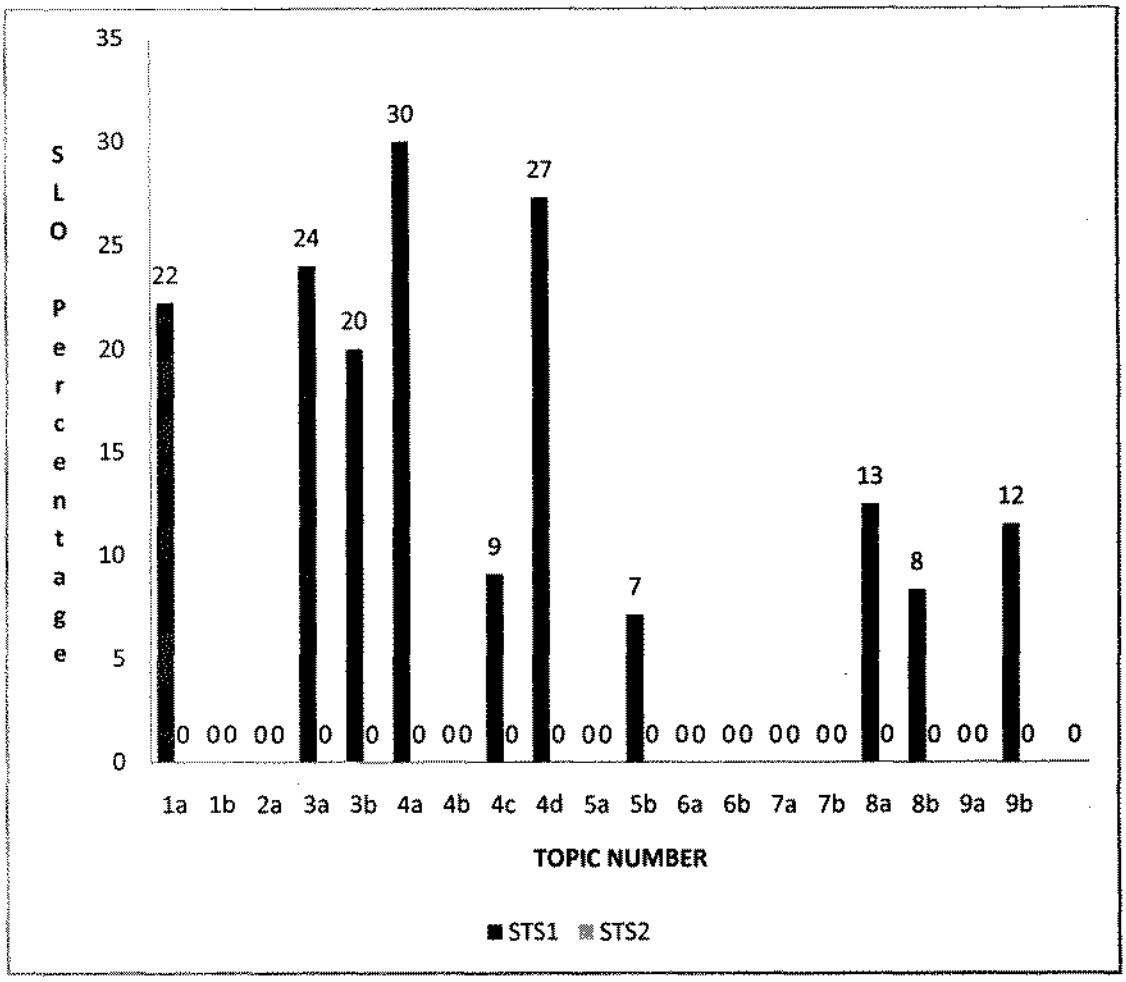

Figure 4.8. Comparison of Written Curriculum and Textbook-Grade IX: Fine Grain Level- Subcategory STS Connection (*1=Written Curriculum, 2= Textbook)*

Figure 4.8 compares written curriculum and textbook-Grade IX with respect to cognitive demand's subcategory STS Connection at fine grain level. It shows that there is a complete mismatch between the textbook-Grade IX and the written curriculum with respect to STS Connection subcategory of cognitive demand as textbook-Grade IX has no content about the STS connection contrary to that of written curriculum that has 0% to 30% SLOs for various topics.

Table 4.3

Alignment of Written Curriculum with Textbook-Grade X: Fine Grain Level

Topic Number	Ratio Difference with respect to				
	Remember12	**Understand12**	**Skills12**	**STS12**	**Subtotal**
10a	0.005	0.003	0.000	0.003	0.010
10b	**0.037**	0.000	0.011	**0.026**	**0.074**
11a	0.010	0.004	0.006	0.000	0.020
11b	0.009	0.001	0.002	0.006	0.018
12a	0.008	0.001	0.002	0.007	0.017
12b	0.004	0.004	0.004	0.012	0.024
12c	0.014	0.001	0.002	0.017	0.035
13a	0.003	0.001	0.002	0.006	0.012
13b	0.003	0.001	0.001	0.005	0.011
13c	0.020	0.008	0.000	0.012	**0.040**
14a	0.016	0.025	0.003	0.012	**0.056**
14b	0.004	0.004	0.000	0.000	0.009
14c	0.020	0.013	0.002	0.009	**0.043**
15a	0.023	0.001	0.004	0.018	**0.045**
15b	0.006	0.001	0.001	0.009	0.018
16a	0.009	0.006	0.001	0.003	0.019
16b	0.020	0.010	0.004	0.014	**0.048**
17a	0.014	0.014	0.000	0.000	0.029
17b	0.016	0.000	0.000	0.016	0.032
18a	0.008	0.004	0.000	0.004	0.016
18b	0.028	0.012	0.000	0.016	**0.056**
Total	**0.278**	**0.113**	**0.043**	**0.197**	**0.631**
		Alignment Index			**0.68**

Note: 12= Between Written Curriculum and Textbooks, STS=STS Connection

Table 4.3 shows alignment of written curriculum with textbook-Grade X at fine grain level. It shows that the alignment index between written curriculum and textbook –Grade X is 0.68 which reflects a considerable misalignment level. This misalignment varies across the topics as well as subcategories of cognitive demand. The subcategory STS connection (sum of ratio difference is 0.197) and topics 10b, 14b, and 18b (sum of ratio difference ranges from 0.056 to 0.074) are misaligned to the critical level. Similarly, topics 13c, 14c, 15a, and 16b (sum of ratio difference ranges from 0.040 to 0.048) are significantly misaligned, while the topics 12c, and 17b (ratio difference ranges from 0.032 to 0.035) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 10b, 13c, 14c, 15a, 16b, and 18b are critically misaligned (ratio difference ranges from 0.020 to 0.037), the topics 14a, and 17b are significantly misaligned (ratio difference is 0.016), (b) with respect to Understand subcategory, the topics 14a, 14c, 17a, and 18b are critically misaligned (ratio difference ranges from 0.012 to 0.025), and (c) with respect to STS Connection subcategory, the topics 10b, 12b, 12c, 13c, 14a, 15a, 16c, 17b, and 18b are critically misaligned (ratio difference ranges from 0.012 to 0.026), the topic 14c and 15b are significantly misaligned (ratio difference is 0.009).

The Textbook-X has no content for SLO relating to STS Connection (Fig. 4.12) unlike that of proposed in the written curriculum. This is causing misalignment between the Textbook-X and the written curriculum. This is important for both textbook and curriculum developer.

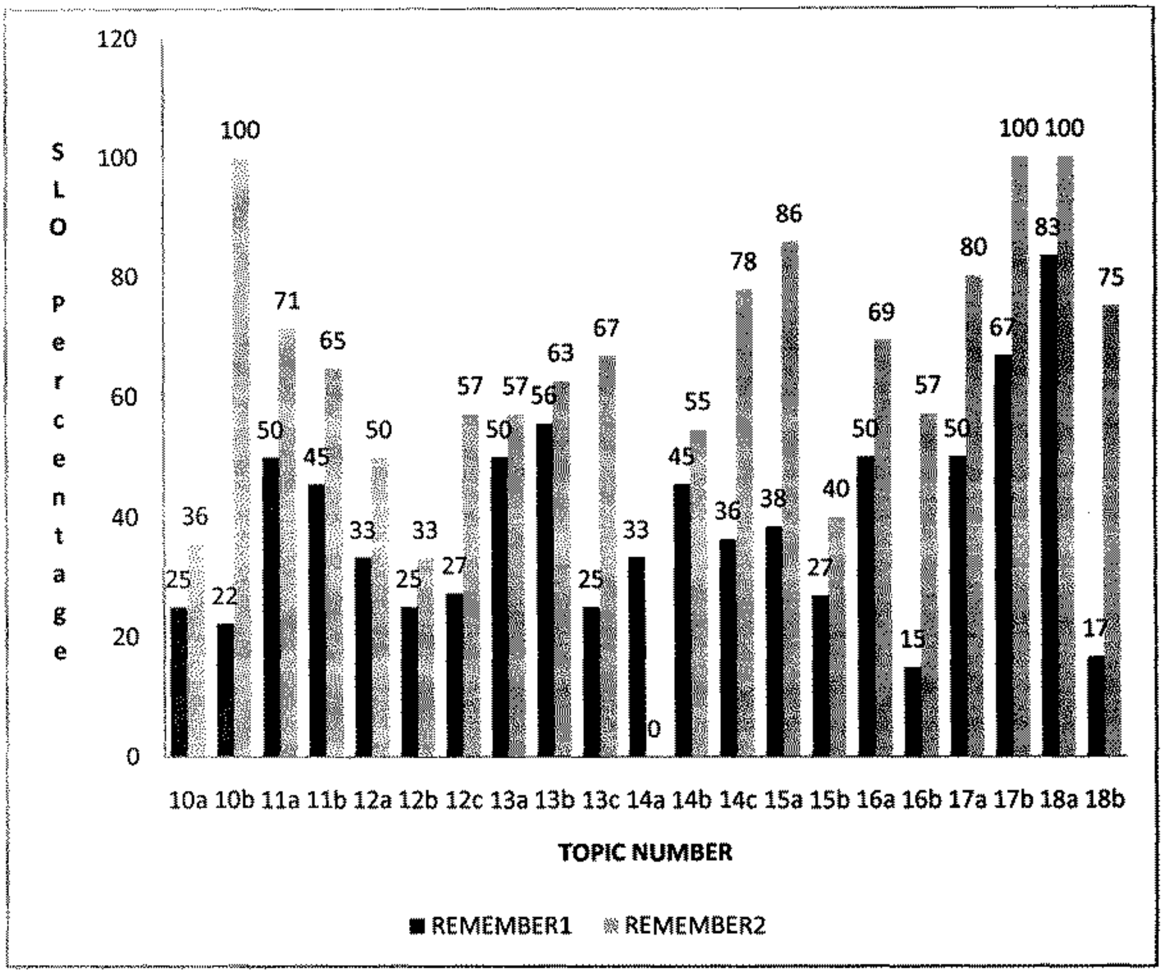

Figure 4.9. Comparison of Written Curriculum and Textbook-Grade X: Fine Grain Level- Subcategory Remember (*1=Written Curriculum, 2= Textbook)*

Figure 4.9 compares written curriculum and textbook-Grade X with respect to cognitive demand's subcategory remember at fine grain level. It shows that, at fine grain level, there is no topic in which the textbook-Grade X and written curriculum are completely aligned with respect to Remember subcategory of cognitive demand (the difference of SLO percentage ranges from 7% to 88%). SLO percentage of all the topics in textbooks- Grade X is much higher than that of written curriculum. This gap can be particularly seen in the topic numbers 10b, 12c, 13c, 14a, 14c, 15a, 16b, 17a, 17b, and 18b (difference of SLO Percentages ranges from 30% to 78%). However, this gap between the textbook and written curriculum is less (difference of SLO Percentages ranges from 7% to 10%) in topics 12b, 13a, 13b, and 14b.

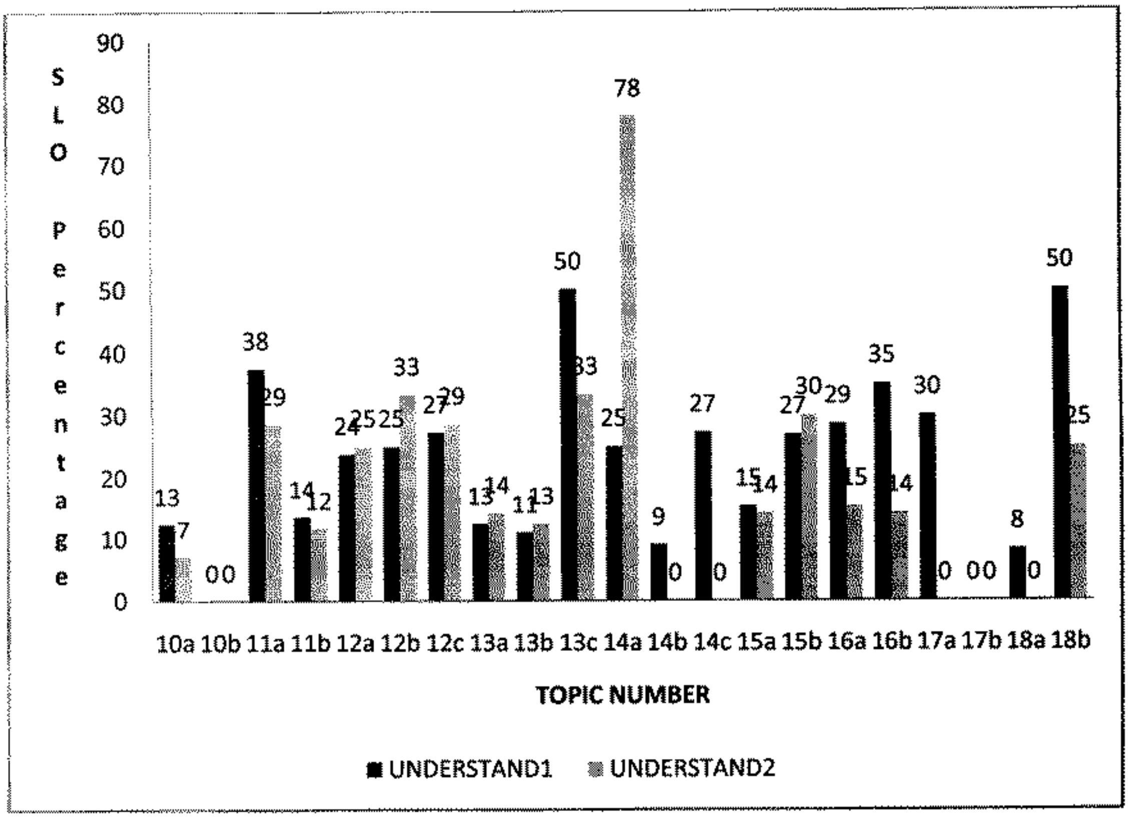

Figure 4.10. Comparison of Written Curriculum and Textbook-Grade X: Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 2= Textbook*)

Figure 4.10 compares written curriculum and textbook-Grade X with respect to cognitive demand's subcategory understand at fine grain level. It shows that at fine grain level, there is no topic in which the textbook-Grade X and written curriculum are completely aligned with respect to Understand subcategory of cognitive demand (the difference of SLO percentage ranges from 1% to 53%). Except topic 14a, SLO percentage of all the topics in textbooks- Grade X is less than that of written curriculum. This gap can be particularly seen in the topic numbers 10b 13c, 14a, 14c, 16b, and 17c (difference of SLO Percentages ranges from 30% to 42%). However, this gap between the textbook and written curriculum is less (SLO Percentages ranges from 1% to 5%) in topics 11b, 12a, 12c, 13a, 13b, 15a, and15b.

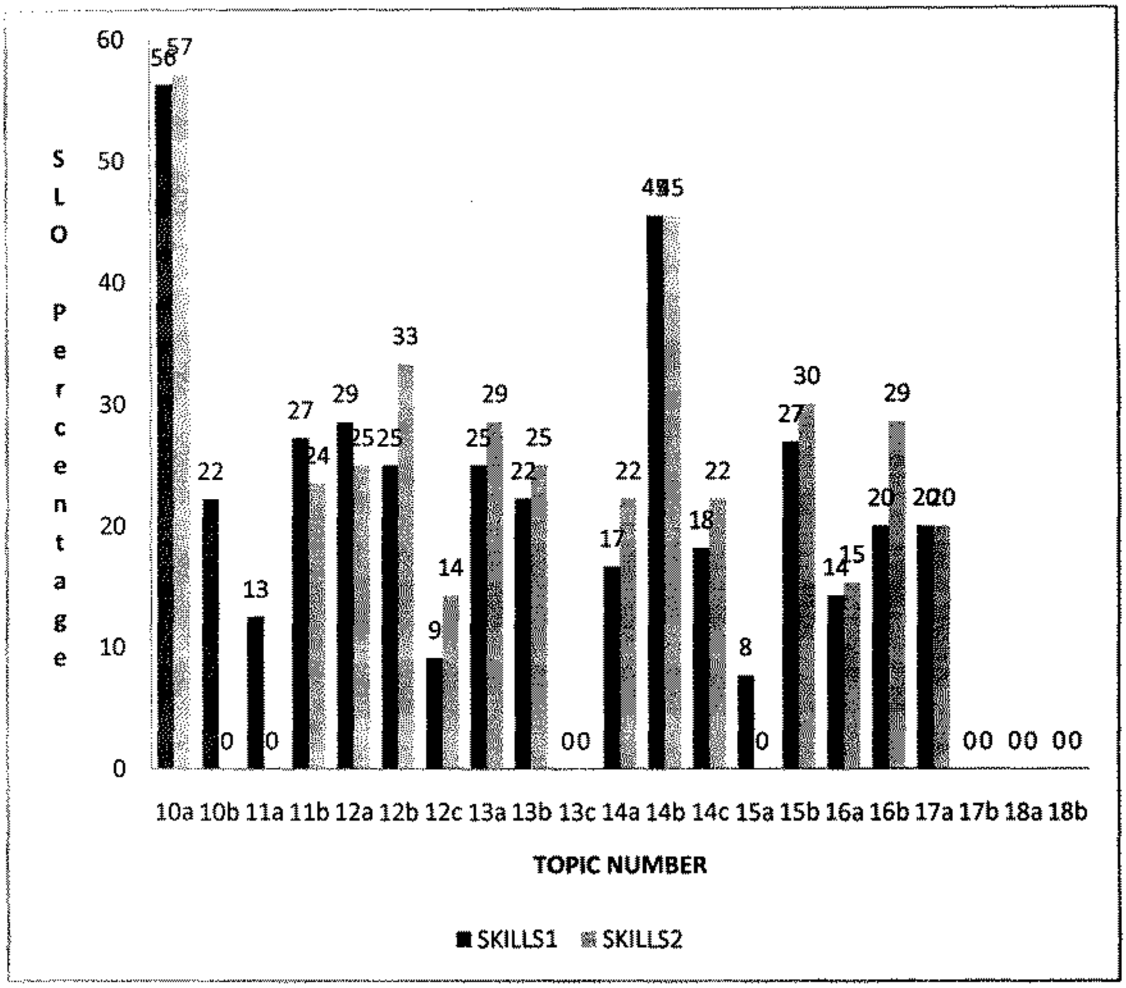

Figure 4.11. Comparison of Written Curriculum and Textbook-Grade X: Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 2= Textbook)*

Figure 4.11 compares written curriculum and textbook-Grade X with respect to cognitive demand's subcategory Skills at fine grain level. It shows that there is comparatively more alignment between the textbook-Grade X and the written curriculum with respect to Skills subcategory of cognitive demand. However, there are some topics (10b, 11a, and 15a) where textbook has no SLOs contrary to the demand of written curriculum.

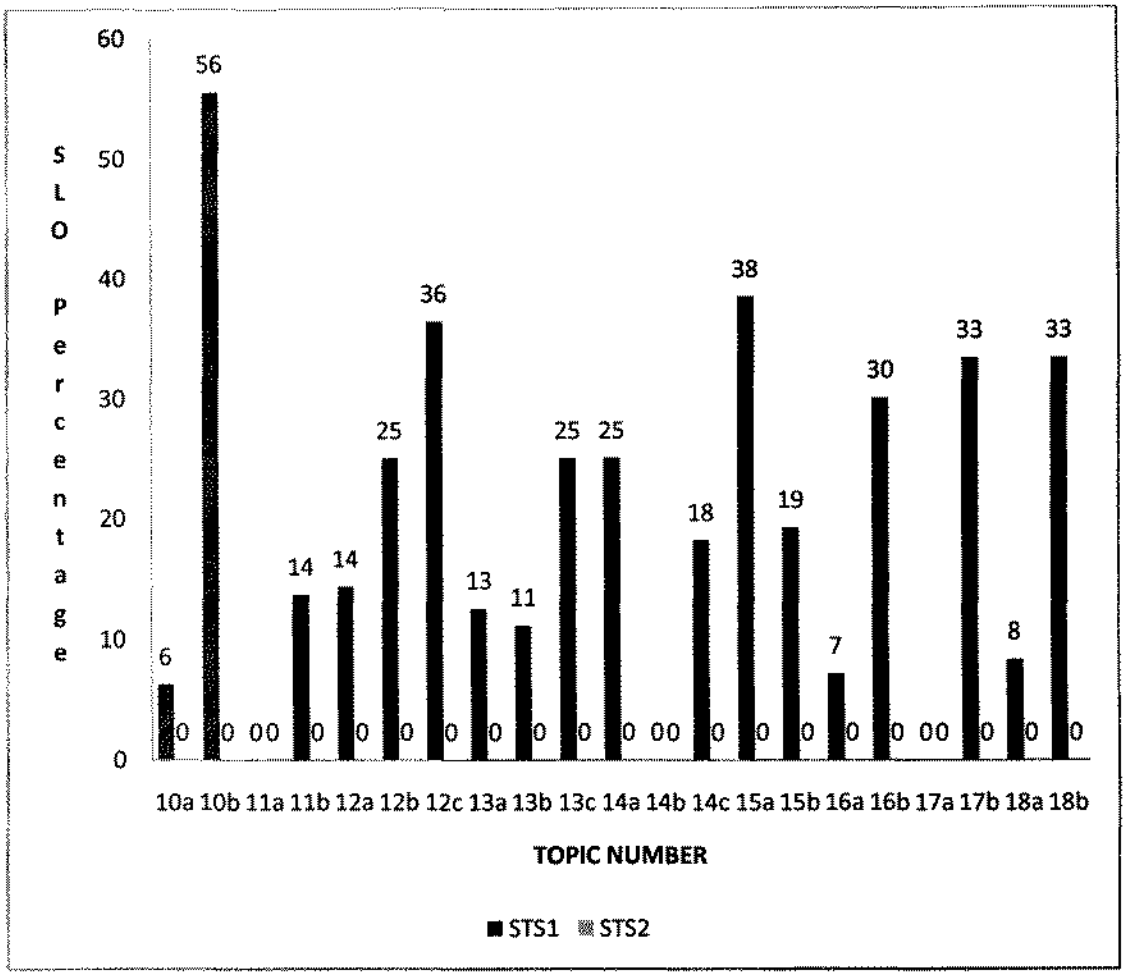

Figure 4.12. Comparison of Written Curriculum and Textbook-Grade X: Fine Grain Level- Subcategory STS Connection (*1=Written Curriculum, 2= Textbook)*

Figure 4.12 compares written curriculum and textbook-Grade X with respect to cognitive demand's subcategory STS Connection at fine grain level. It shows that a wide gap exists in the textbook and the written curriculum with respect to STS Connection as the textbook provides no content relating to this subcategory contrary to the demands of written curriculum.

Table 4.4

Alignment level of Written Curriculum and Question Papers by BISE (L): Coarse Grain Level

Section Number	Ratio Difference with respect to				
	Remember14	**Understand14**	**Skills14**	**STS14**	**Subtotal**
A	0.036	0.007	0.003	0.026	0.072
B	0.049	0.015	0.024	0.011	0.099
C	0.049	0.018	0.007	0.024	0.098
D	0.028	0.015	0.021	0.034	0.099
E	0.093	0.029	0.029	0.034	**0.185**
F	0.042	0.013	0.000	0.029	0.083
Total	**0.297**	**0.096**	**0.042**	**0.158**	**0.636**
	Alignment Index				**0.68**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.4 shows alignment level of written curriculum and question papers by BISE (L) at coarse grain level. It shows that the alignment index between written curriculum and question papers by BISE (L) at coarse grain level is 0.68 which reflects a considerable misalignment level. This misalignment varies across the sections as well as subcategories of cognitive demand. The subcategory STS Connection (sum of ratio difference is 0.158) and section E (sum of ratio difference is 0.185) are misaligned to the critical level. Similarly, subcategory Remember (sum of ratio difference 0.297) is considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the section E is critically misaligned (ratio difference 0.093), the sections B and C are considerably misaligned (ratio difference is 0.049), (b) with respect to Understand subcategory, the section E is considerably misaligned (sum of ratio difference is 0.029), and (c) with respect to STS Connection subcategory, all sections (except section B) are critically misaligned (ratio difference ranges from 0.024 to 0.034).

Although Section F is major contributor for misalignment between the question papers administered by BISE (L) and the written curriculum, other Sections have also increased the level of misalignment. The reason of this disparity is unmatched distribution of items relating to different categories of cognitive demand. It shows that the table of specification given in the written curriculum is not taken into consideration while developing items for question papers.

Table 4.5

Alignment level of Written Curriculum and Question Papers by BISE (M): Coarse Grain Level

Section Number	Ratio Difference with respect to				
	Remember14	**Understand14**	**Skills14**	**STS14**	**Subtotal**
A	0.025	0.011	0.011	0.026	0.073
B	0.059	0.022	0.027	0.011	**0.118**
C	0.033	0.001	0.008	0.024	0.067
D	0.038	0.013	0.009	0.034	0.094
E	0.084	0.021	0.029	0.034	**0.169**
F	0.003	0.014	0.012	0.029	0.058
Total	**0.244**	**0.082**	**0.096**	**0.158**	**0.579**
		Alignment Index			**0.71**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.5 shows alignment level of written curriculum and question papers by BISE (M) at coarse grain level. It shows that the alignment index between written curriculum and question papers by BISE (M) at coarse grain level is 0.71 which reflects a considerable level of alignment between the two. However, this alignment is not spread across all sections as well as subcategories of cognitive demand. For example, the subcategory STS connection (sum of ratio difference is 0.158) and section E (sum of ratio difference 0.169) are misaligned to the critical level. Similarly, section B (sum of ratio difference 0.118) and subcategory Remember (sum of ratio difference 0.244) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the section E is critically misaligned (sum of ratio difference 0.084) and the section B is significantly misaligned (ratio difference is 0.059), (b) with respect to Skills subcategory, the sections B and E are considerably misaligned (ratio difference ranges from 0.027 to 0.029), and (c) with respect to STS Connection subcategory, all sections (except section B) are critically misaligned (ratio difference ranges from 0.029 to 0.034).

Sections B and E are particularly contributing towards misalignment between the question papers administered by BISE (M) and the written curriculum. This misalignment can be minimised if the gap between the items distribution in question papers and SLO suggested in written curriculum with respect to all categories of cognitive demand (see also Figs. 4.16-4.20) is reduced. Alignment would increase if question papers contain fewer items relating to Remember subcategory and more items relating to Understand and STS subcategories of cognitive demand.

Table 4.6

Alignment level of Written Curriculum and Question Papers by BISE (N): Coarse Grain Level

Section Number	Ratio Difference with respect to				
	Remember14	**Understand14**	**Skills14**	**STS14**	**Subtotal**
A	0.055	0.007	0.023	0.026	**0.109**
B	0.036	0.005	0.020	0.011	0.072
C	0.043	0.020	0.001	0.024	0.089
D	0.009	0.018	0.007	0.034	0.068
E	0.046	0.012	0.000	0.034	0.093
F	0.042	0.004	0.008	0.029	0.083
Total	**0.231**	**0.067**	**0.060**	**0.158**	**0.515**
		Alignment Index			**0.74**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.6 shows alignment level of written curriculum and question papers by BISE (N) at coarse grain level. It shows that the alignment index between written curriculum and question papers by BISE (N) at coarse grain level is 0.74 which reflect a considerable level of alignment. However, this alignment is not spread across all sections as well as subcategories of cognitive demand. For example, the subcategory STS connection (sum of ratio difference is 0.158) is misaligned to the critical level. Similarly, section A (sum of ratio difference 0.109) is considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the sections A, C, E, and F are significantly misaligned (ratio difference ranges from 0.042 to 0.055), and (b) with respect to STS Connection subcategory, all sections (except section B) are critically misaligned (ratio difference ranges from 0.024 to 0.034).

Major factor responsible for misalignment between the question papers administered by BISE (N) and the written curriculum is unmatched distribution of items with respect to SLO of different categories (Figures 4.16-4.20). Unlike suggestions in the written curriculum, question papers contain more items relating to Remember subcategory, less items relating to Understand subcategory and no items relating to STS Connection subcategory. This trend is same as that of textbooks and this similarity of trend indicates that the question papers were developed from the textbooks.

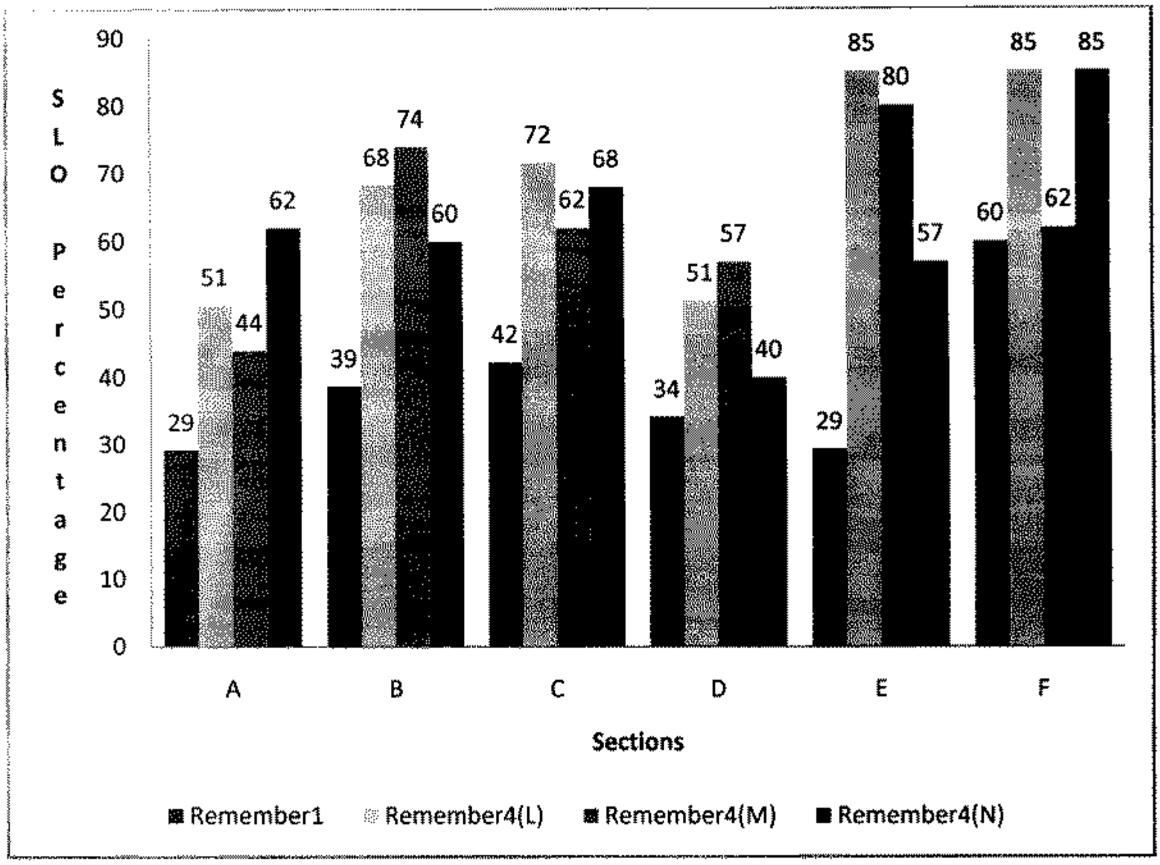

Figure 4.13. Comparison of Written Curriculum and the Question Papers by BISEs (L-N): Coarse Grain Level- Subcategory Remember *(1=Written Curriculum, 4=Question Papers, L=BISE (L), L=BISE (M), L=BISE (N))*

Figure 4.13 compares written curriculum and question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory Remember. It shows that question papers from all BISEs, at coarse grain level, give more emphasis to the remember subcategory than that of given in the written curriculum. However, the misalignment varies across the sections (SLO percentage difference ranges from 5% to 56%) varies across the sections. For example, question papers by BISEs and written curriculum are comparatively more aligned (SLO percentage difference ranges from 5% to 56%) in section D, and less aligned (SLO percentage difference 16% to 23%) in section E.

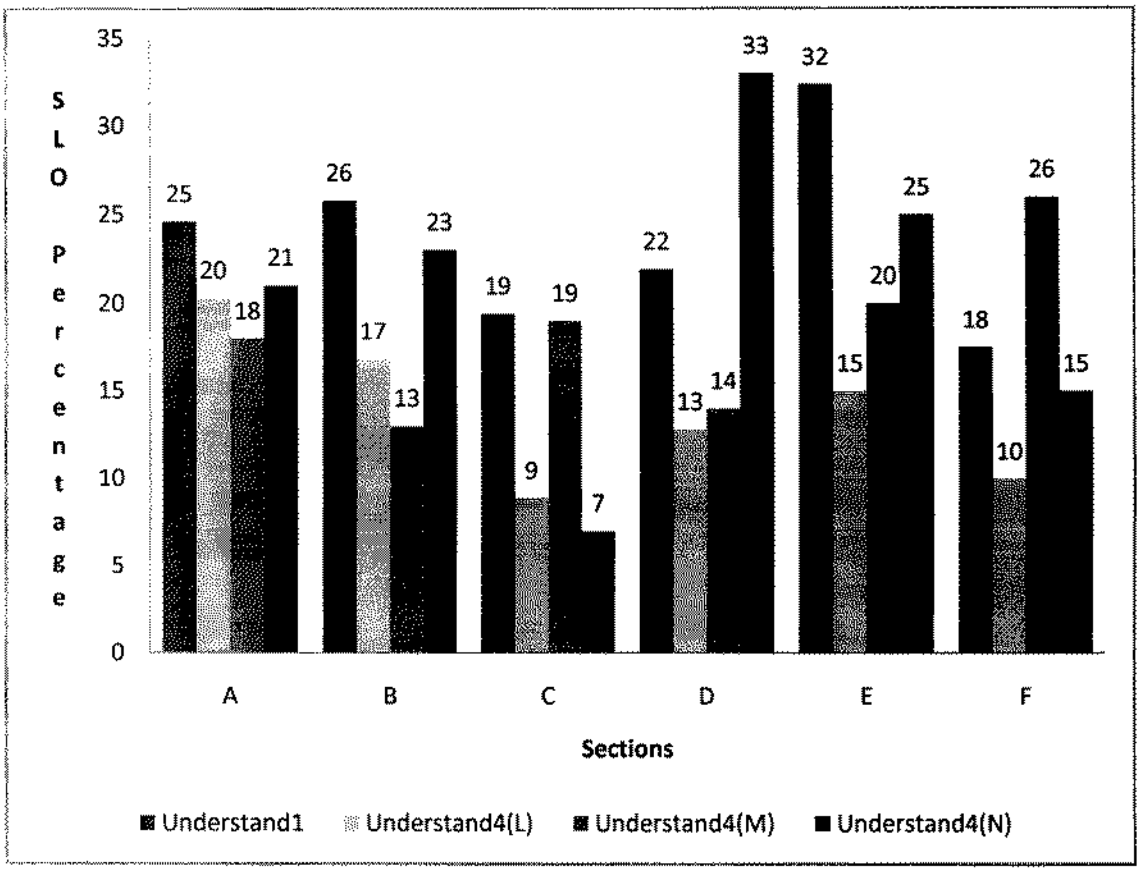

Figure 4.14. Comparison of Written Curriculum and the Question Papers by BISEs (L-N): Coarse Grain Level- Subcategory Understand *(1=Written Curriculum, 4=Question Papers, L=BISE (L), L=BISE (M), L=BISE (N))*

Figure 4.14 compares written curriculum and question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory Understand. It shows that, at coarse grain level with respect to cognitive demand's subcategory Understand, the question papers of none of the BISEs are aligned with the written curriculum (difference of SLO percentage ranges from 4% to 20%). Question papers from nearly most of the BISEs (excluding BISE (N) in section D and BISE (M) in section F) contain items relating to understand subcategory in lesser proportion (difference of SLO percentage ranges from 4% to 20%) than given in written curriculum. However, the difference of SLO percentage varies across the sections. This difference is comparatively less (4% to 7%) in section A and comparatively high (11% to 20%) in section D.

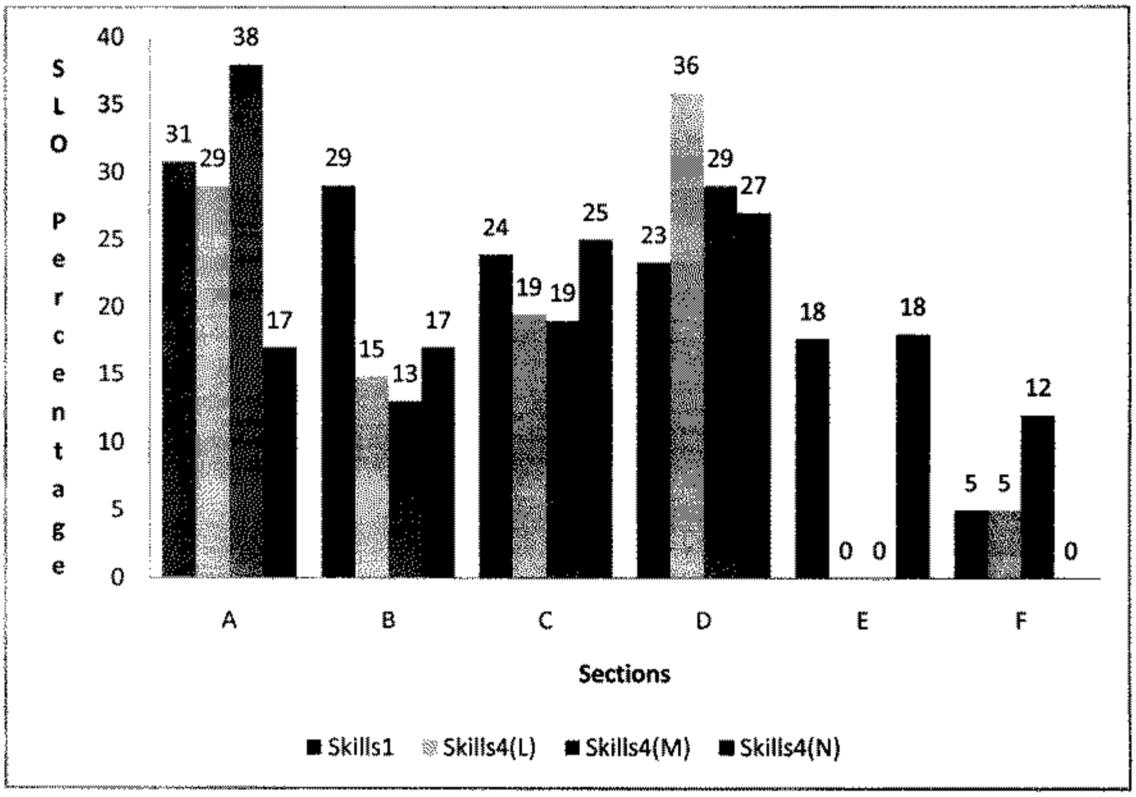

Figure 4.15. Comparison of Written Curriculum and the Question Papers by BISEs (L-N): Coarse Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers, L=BISE (L), L=BISE (M), L=BISE (N)*)

Figure 4.15 compares written curriculum and question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory Skills. It shows that a significant gap (SLO percentage difference ranges from 1%, to 21%) exists between the written curriculum and that of question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory Skills. Except BISE (L) only for Section F, there is not a single BISE that has administered question papers with the same proportion of items as given in the written curriculum with respect to skills subcategory. However, there is difference in SLO percentage varies across BISEs as well as sections. There is relatively less gap (SLO percentage difference ranges from 1%, to 13%) in emphasis on subcategory skills between in sections C and D as compared to other sections (SLO percentage difference ranges from 5%, to 21%).

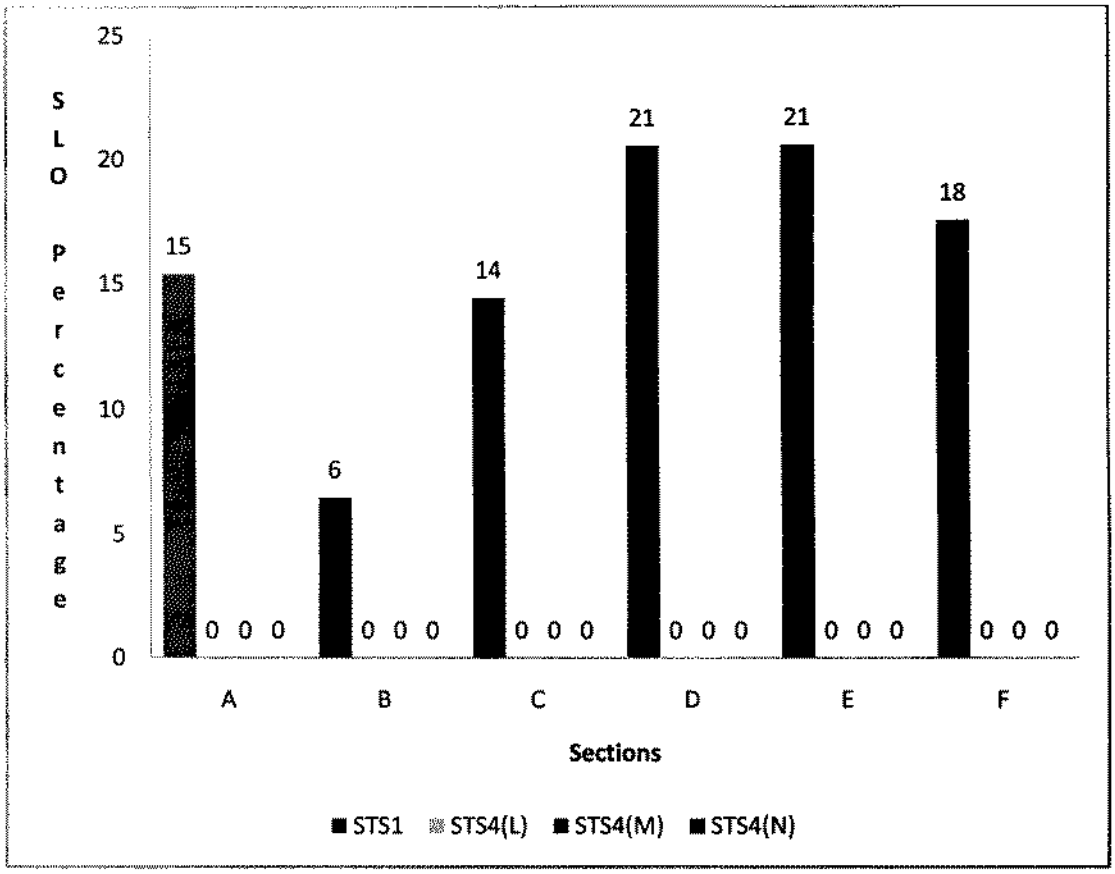

Figure 4.16. Comparison of Written Curriculum and the Question Papers by BISEs (L-N): Coarse Grain Level- Subcategory STS Connection (*1=Written Curriculum, 4=Question Papers, L=BISE (L), L=BISE (M), L=BISE (N))*

Figure 4.16 compares written curriculum and question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory STS Connection. It shows that a significant gap (SLO percentage difference ranges from 6%, to 21%) exists between the written curriculum and that of question papers by BISEs (L-N) at coarse grain level with respect to cognitive demand's subcategory STS Connection. The question papers from none of the BISEs consist of any item with respect to cognitive demand's subcategory. On the other hand, in written curriculum considerable SLOs percentage (ranges from 6% to 21%) consists of subcategory of STS Connection.

Table 4.7

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE L (Grade IX)

Topic Number	Ratio Difference with respect to				Subtotal
	Remember14	**Understand14**	**Skills14**	**STS14**	
1a	0.010	0.008	0.000	0.012	0.030
1b	0.000	0.007	0.013	0.000	0.020
2a	0.020	0.002	0.012	0.000	**0.035**
3a	0.040	0.011	0.011	0.013	**0.074**
3b	0.016	0.011	0.016	0.011	**0.053**
4a	0.001	0.031	0.011	0.016	**0.059**
4b	0.035	0.006	0.023	0.000	**0.064**
4c	0.004	0.039	0.024	0.005	**0.072**
4d	0.044	0.010	0.014	0.014	**0.083**
5a	0.022	0.002	0.014	0.000	**0.038**
5b	0.036	0.019	0.008	0.004	**0.066**
6a	0.011	0.004	0.000	0.000	0.015
6b	0.011	0.021	0.021	0.000	**0.053**
7a	0.009	0.009	0.007	0.000	0.025
7b	0.012	0.018	0.012	0.000	**0.041**
8a	0.033	0.015	0.005	0.007	**0.060**
8b	0.030	0.004	0.045	0.004	**0.083**
9a	0.030	0.017	0.008	0.000	**0.055**
9b	0.024	0.004	0.008	0.006	**0.043**
Total	**0.389**	**0.238**	**0.250**	**0.091**	**0.968**
	Alignment Index				**0.52**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.7 shows alignment of written curriculum with question papers by BISE (L) Grade IX at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (L) Grade IX at fine grain level is 0.52 which reflects a significant misalignment level. This misalignment varies across the topics as well as subcategories of cognitive demand as all topics, except topics 1a, 1b, 6a, and 7b, are misaligned. The topics 3a, 4a, 4b, 4c, 4d, 5b, 8a, 8b, and 9a (sum of ratio difference ranges from 0.055 to 0.074) and subcategory STS connection (sum of ratio difference is 0.091) are misaligned to the critical level. Similarly, topics 3b, 6b, and 9a (sum of ratio difference ranges from 0.043 to 0.053) and subcategories Remember, Understand, and Skills (sum of ratio difference ranges from 0.238 to 0.389) are significantly misaligned, while the topics 2a, 4a, and 7b (sum of ratio difference ranges from 0.035 to 0.041) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 3a, 4b, 4d, 5a, 5b, 8a, 8b, 9a, and 9b are critically misaligned (ratio difference ranges from 0.022 to 0.044), (b) with respect to Understand subcategory, the topics 4a, 4c, 6b, 7b, 8a, and 9a are critically misaligned (ratio difference ranges from 0.015 to 0.031), and (c) with respect to STS Connection subcategory, the topic 4a is critically misaligned (ratio difference is 0.016), the topics 1a, 3a, and 4d are significantly misaligned (ratio difference ranges from 0.012 to 0.014).

The question papers Grade IX administered by BISE (L) do not cover SLO relating to different categories of cognitive demand as proposed in the written curriculum. More items relating to Remember category and fewer items relating to other categories is causing lack of alignment between the question papers Grade IX administered by BISE (L) and the written curriculum at fine grain level.

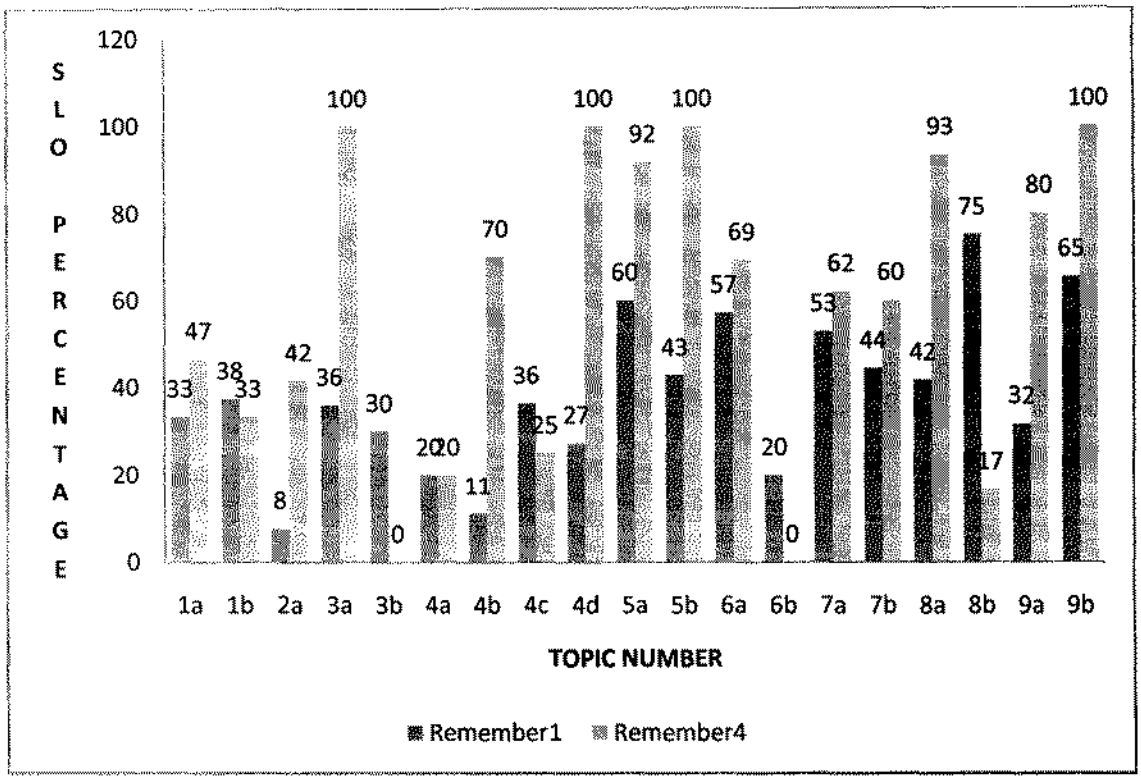

Figure 4.17. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (L): Fine Grain Level- Subcategory Remember (*1=Written Curriculum, 4=Question Papers)*

Figure 4.17 compares written curriculum and question papers (Grade-IX) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that, except in case of topic 4a, there is not a single topic in which there is complete alignment between the question papers from BISE (L) and the written curriculum at fine grain level. Moreover, in most of the topics (68% topics) question papers from BISE (L) give more emphasis to the remember subcategory than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. For example, the difference of SLO percentage is comparatively less (ranges from 5% to 15%) in topics 1a, 1b, 4c, 6a, and 7b, and maximum (ranges from 35% to 73%) in topics 3a, 4b, 4d, 5a, 5b, 8a, 8b, 9a, and 9b.

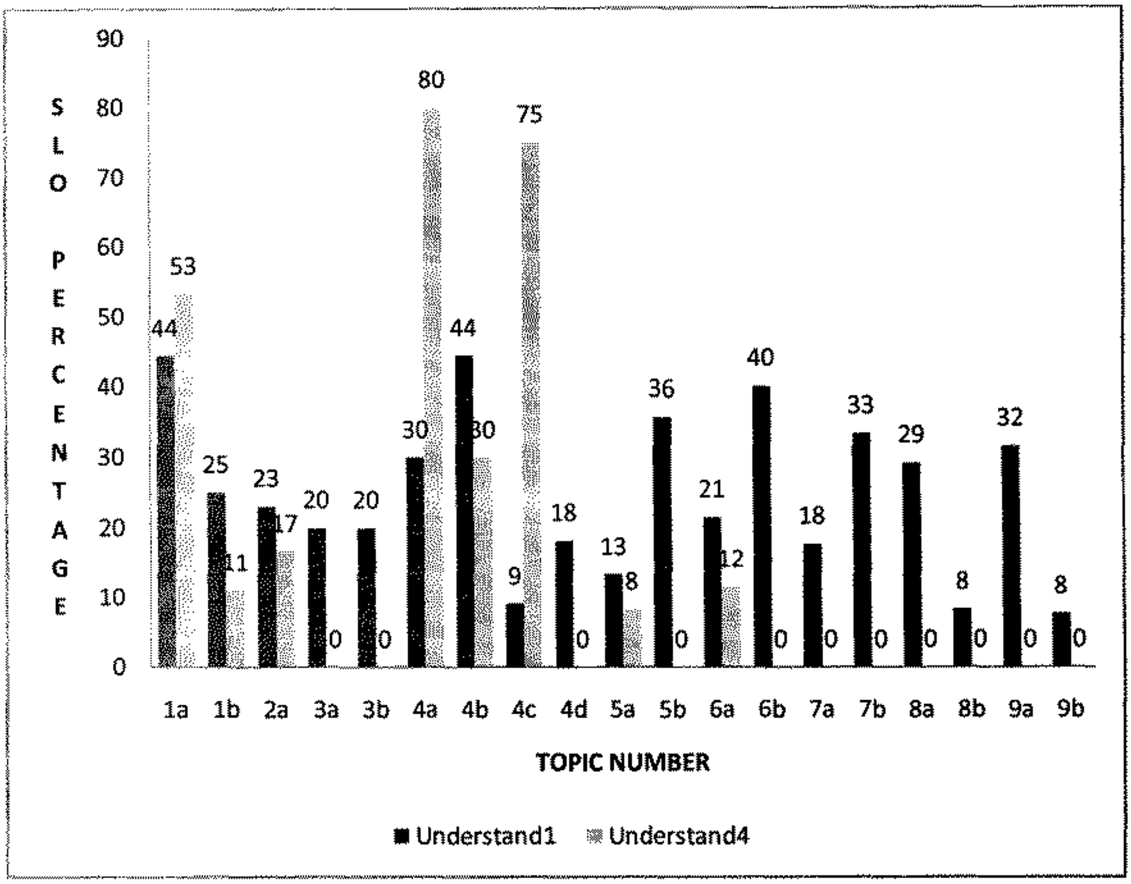

Figure 4.18. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (L): Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 4=Question Papers)*

Figure 4.18 compares written curriculum and question papers (Grade-IX) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (L) and the written curriculum at fine grain level. Moreover, question papers (Grade-IX) from BISE (L) do not contain even a single item with respect to understand subcategory from most of the topics (58% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 5% to 14%) in topics 1a, 1b, 2a, 4b, 5a, and 6a, and maximum (ranges from 35% to 66%) in topics 4b, 4c, 5b, and 6b.

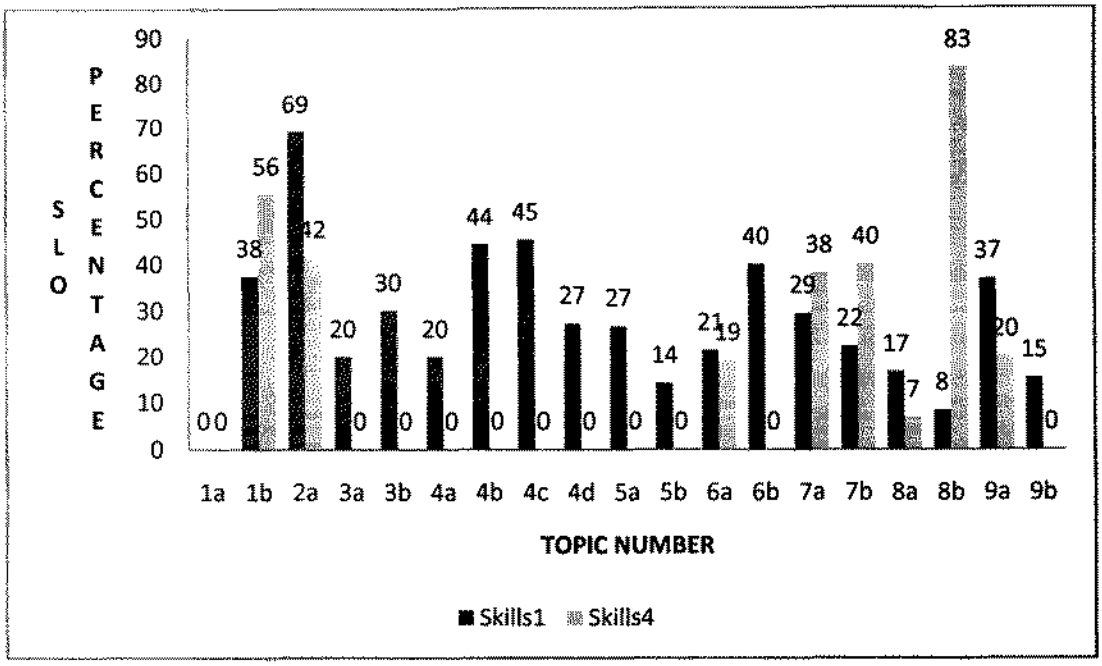

Figure 4.19. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (L): Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers)*

Figure 4.19 compares written curriculum and question papers (Grade-IX) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (L) and the written curriculum at fine grain level. Moreover, question papers (Grade-IX) from BISE (L) do not contain even a single item with respect to Skills subcategory from most of the topics (53% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 18%) in topics 1b, 6a, 7a, 7b, 8a, and 9a, and maximum (ranges from 27% to 75%) in topics 2a, 3b, 4b, 4c, 4d, 4a, 6b, and 8b.

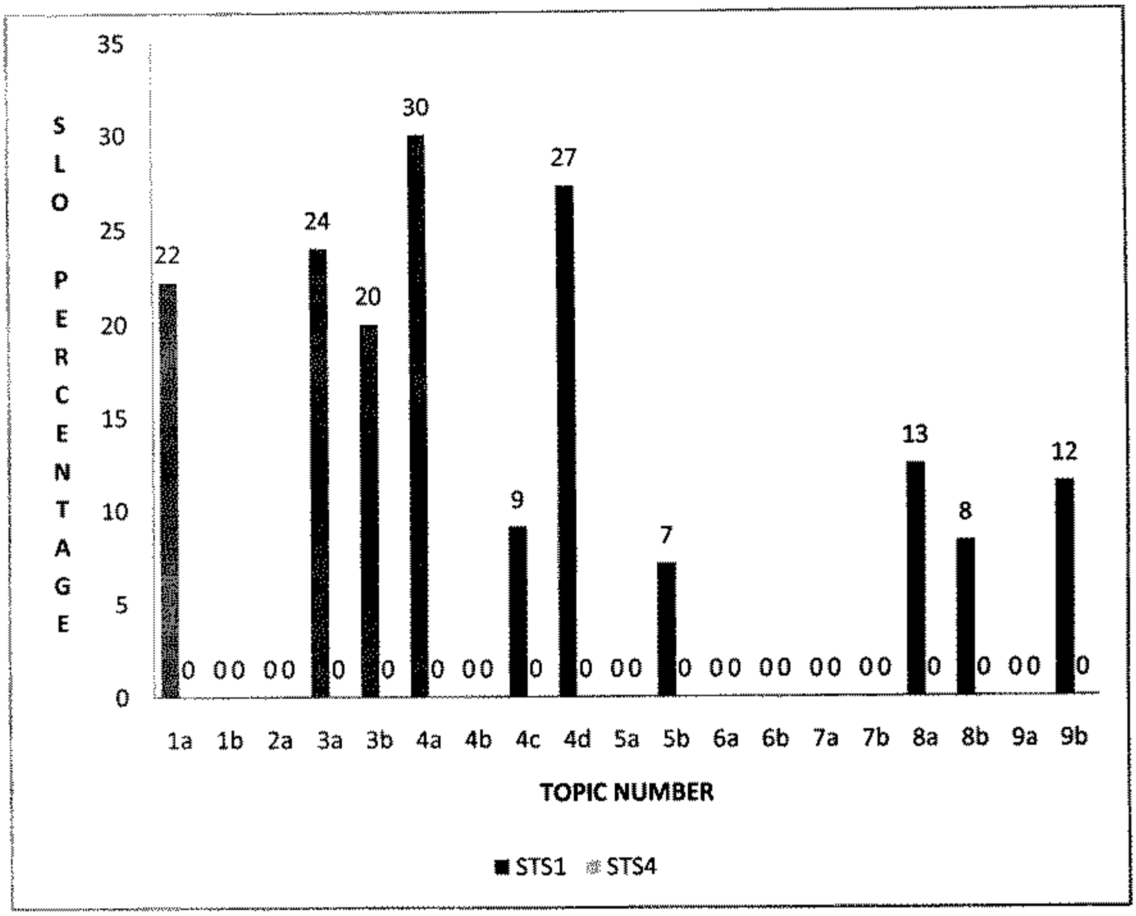

Figure 4.20. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (L): Fine Grain Level- Subcategory STS Connection (*1=Written Curriculum, 4=Question Papers)*

Figure 4.20 compares written curriculum and question papers (Grade-IX) by BISE (L) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (L) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade-IX) from the BISE (L) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 8% to 30%) consists of subcategory of STS Connection.

Table 4.8

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE L (Grade X)

Topic Number	Ratio Difference with respect to				
	Remember14	Understand14	Skills14	STS14	Subtotal
10a	0.010	0.007	0.014	0.003	**0.034**
10b	0.004	0.014	0.008	0.026	**0.053**
11a	0.015	0.009	0.024	0.000	**0.048**
11b	0.026	0.006	0.013	0.006	**0.052**
12a	0.032	0.011	0.014	0.007	**0.063**
12b	0.036	0.012	0.012	0.012	**0.071**
12c	0.035	0.013	0.004	0.017	**0.069**
13a	0.017	0.001	0.012	0.006	**0.036**
13b	0.002	0.014	0.011	0.005	**0.032**
13c	0.036	0.024	0.000	0.012	**0.071**
14a	0.001	0.007	0.018	0.012	**0.038**
14b	0.022	0.004	0.026	0.000	**0.052**
14c	0.021	0.013	0.001	0.009	**0.043**
15a	0.029	0.007	0.004	0.018	**0.059**
15b	0.014	0.008	0.013	0.009	**0.044**
16a	0.016	0.006	0.007	0.003	**0.032**
16b	0.035	0.011	0.010	0.014	**0.069**
17a	0.024	0.014	0.010	0.000	**0.048**
17b	0.009	0.000	0.007	0.016	**0.032**
18a	0.008	0.004	0.000	0.004	0.016
18b	0.021	0.005	0.000	0.016	**0.041**
Total	**0.410**	**0.191**	**0.206**	**0.197**	**1.003**
	Alignment Index				**0.50**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.8 shows alignment of written curriculum with question papers by BISE (L) Grade X at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (L) Grade X at fine grain level is 0.50 which reflects a significant misalignment level. This misalignment varies across the topics as well as subcategories of cognitive demand as all topics, except topics18a, are misaligned. The topics 10b, 11b, 12a, 12b, 12c, 13c, 14b, 15a, and 16b (sum of ratio difference ranges from 0.052 to 0.071) and subcategories Remember and STS connection (sum of ratio difference are 0.410 and 0.191) are misaligned to the critical level. Similarly, topics 11a, 14c, 15b, 17a, and 18b (sum of ratio difference ranges from 0.041 to 0.048) and subcategories Understand and Skills (sum of ratio difference ranges from 0.191 to 0.206) are significantly misaligned, while the topics 10a, 13a, 13b, 14a, 16a, and 17b (ratio difference ranges from 0.032 to 0.038) are considerably misaligned.

The misalignment between the question papers Grade X administered by BISE (L) and the written curriculum at fine grain level is because there are more items relating to Remember subcategory, particularly in the topics 11b, 12a, 12b, 12c, 13c, 14b, 14c, 15a, 16b, 17a, and 18b (ratio difference ranges from 0.021 to 0.036). The misalignment is because the question papers Grade X administered by BISE (L) contain less or no items (a) with respect to Understand category in the topics 10b, 12a, 12b, 12c, 13b, 13c, 14c, 16b, and 17a (ratio difference ranges from 0.011 to 0.014), (b) with respect to Skills subcategory in the topics 10a, 11a, 11b, 12a, 12b, 13a, 13b, 14a, 14b and 15b (ratio difference ranges from 0.011 to 0.024), and (c) with respect to STS Connection subcategory in the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (ratio difference ranges from 0.012 and 0.026).

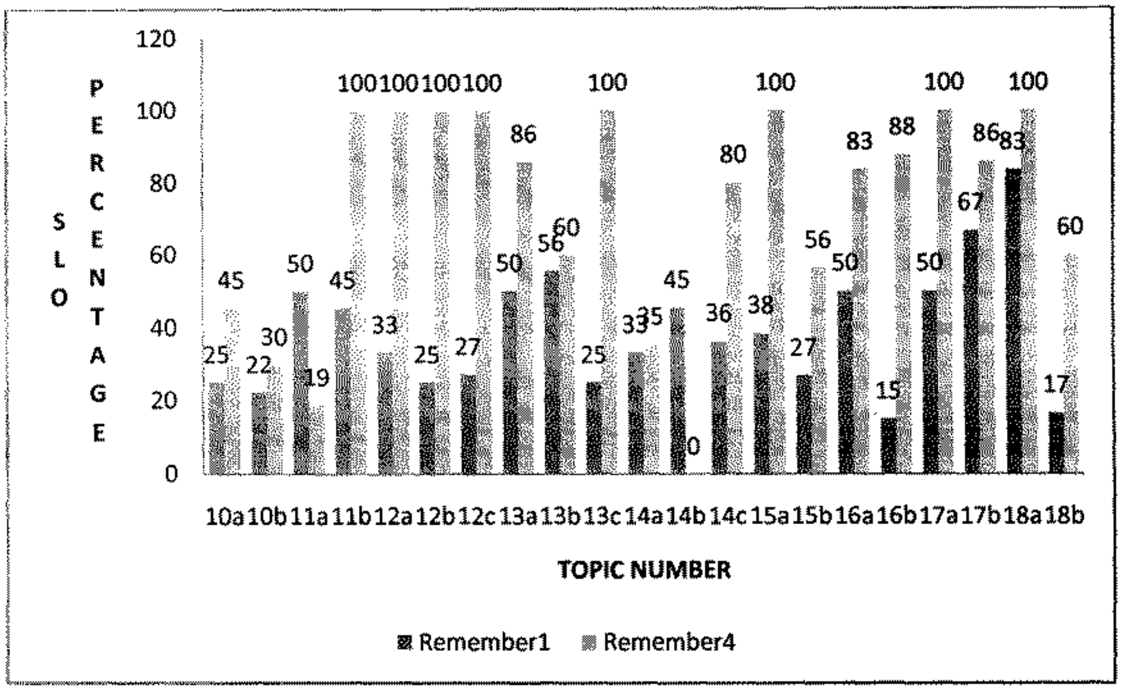

Figure 4.21. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (L): Fine Grain Level- Subcategory Remember (*1=Written Curriculum, 4=Question Papers)*

Figure 4.21 compares written curriculum and question papers (Grade-X) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (L) and the written curriculum at fine grain level. Moreover, question papers (Grade-X) from BISE (L) give more emphasis to the remember subcategory than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 20%) in topics 10b, 13a, 17b, and 18a, and maximum (ranges from 35% to 75%) in topics 11b, 12a, 12b, 12c, 13a, 13c, 14c, 15a, 16b, 17a, and 18b. Moreover, all the items relating to topics 11b, 12a, 12b, 12c, 13c, 15a, 17a, and 18a in question papers (Grade-X) from BISE (L) are about the remember subcategory contrary to that of given in the written curriculum.

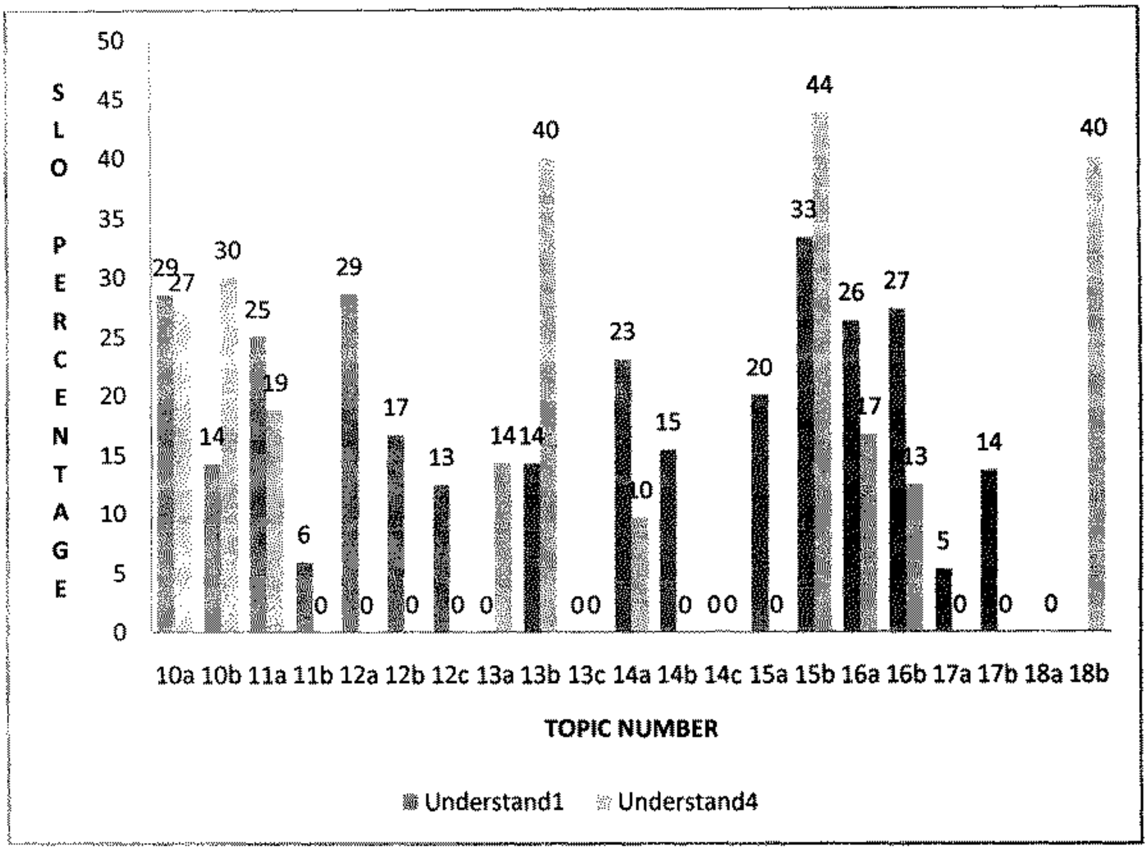

Figure 4.22. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (L): Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 4=Question Papers)*

Figure 4.22 compares written curriculum and question papers (Grade-X) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (L) and the written curriculum at fine grain level. Moreover, question papers from BISE (L) do not contain even a single item with respect to understand subcategory from most of the topics (44% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 15%) in topics 10a, 11a, 14a, 15b, 16a, and 16b, and maximum (ranges from 29% to 40%) in topics 12a 13b, and 18b.

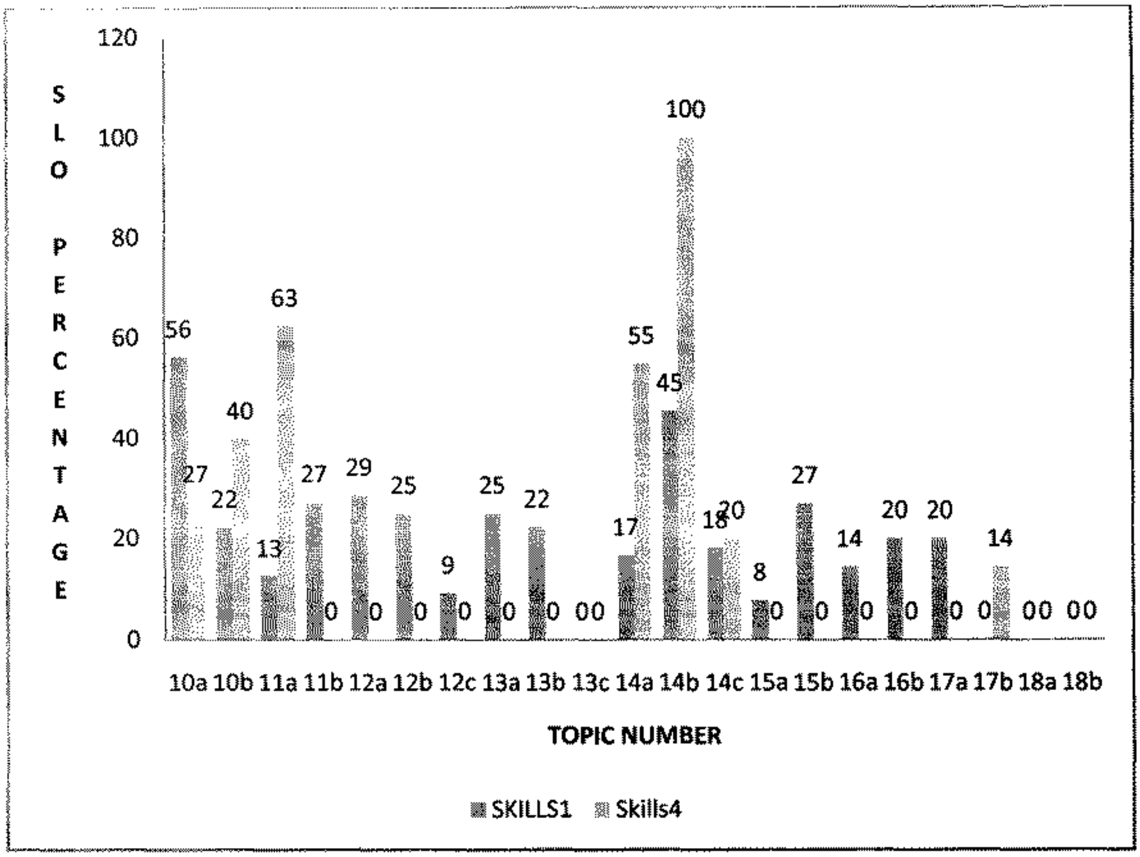

Figure 4.23. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (L): Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers)*

Figure 4.23 compares written curriculum and question papers (Grade-X) by BISE (L) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade X) from BISE (L) and the written curriculum at fine grain level. Moreover, question papers (Grade X) from BISE (L) do not contain even a single item with respect to Skills subcategory from most of the topics (65% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 18%) in topics 10b and 14c, and maximum (ranges from 38% to 55%) in topics 11a, 14a, and 14b.

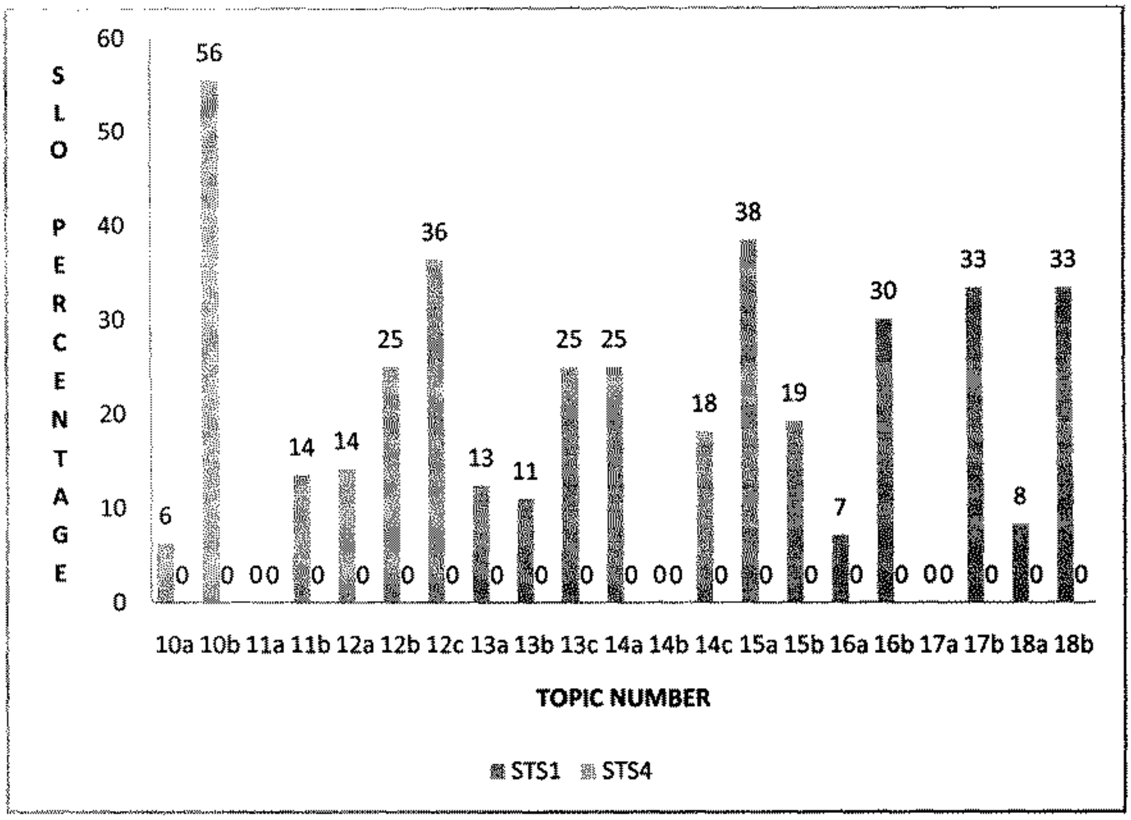

Figure 4.24. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (L): Fine Grain Level- Subcategory STS Connection (*1=Written Curriculum, 4=Question Papers)*

Figure 4.24 compares written curriculum and question papers (Grade-X) by BISE (L) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (L) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade-X) from the BISE (L) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 7% to 56%) consists of subcategory of STS Connection.

Table 4.9

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE M (Grade IX)

Topic Number	Ratio Difference with respect to				
	Remember14	Understand14	Skills14	STS14	Subtotal
1a	0.021	0.009	0.000	0.012	0.042
1b	0.001	0.004	0.004	0.000	0.008
2a	0.028	0.009	0.036	0.000	**0.073**
3a	0.006	0.006	0.025	0.013	0.049
3b	0.037	0.011	0.016	0.011	**0.074**
4a	0.042	0.016	0.011	0.016	**0.084**
4b	0.031	0.023	0.008	0.000	**0.062**
4c	0.013	0.015	0.024	0.005	**0.057**
4d	0.038	0.010	0.014	0.014	**0.077**
5a	0.021	0.007	0.014	0.000	0.042
5b	0.001	0.010	0.008	0.004	0.023
6a	0.011	0.011	0.001	0.000	0.023
6b	0.042	0.021	0.021	0.000	**0.084**
7a	0.012	0.009	0.002	0.000	0.023
7b	0.023	0.035	0.012	0.000	**0.070**
8a	0.016	0.015	0.006	0.007	0.044
8b	0.007	0.002	0.004	0.004	0.018
9a	0.016	0.017	0.000	0.000	0.033
9b	0.008	0.006	0.008	0.006	0.028
Total	0.374	0.236	0.213	0.091	0.914
	Alignment Index				**0.54**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.9 shows alignment of written curriculum with question papers by BISE (M) Grade IX at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (M) Grade IX at fine grain level is 0.54 which reflects a significant misalignment level. This misalignment is spread across the topics as well as subcategories. The topics 2a, 3b, 4a, 4b, 4d, 6b, and 7b (sum of ratio difference ranges from 0.062 to 0.084) and subcategory STS connection (sum of ratio difference is 0.091) are misaligned to the critical level. Similarly, topics 3a, 4c, and 8a (sum of ratio difference ranges from 0.044 to 0.057) and subcategories Remember and Understand (sums of ratio difference are 0.236 and 0.213) are significantly misaligned, while the topics 1a, 5a, and 9a (ratio difference ranges from 0.033 to 0.042) and subcategory Skills (sum of ratio difference is 0.213) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 2a, 3b, 4a, 4b, 4d, and 6b are critically misaligned (ratio difference ranges from 0.028 to 0.042), (b) with respect to Understand subcategory, the topics 4a, 4b, 4c, 6b, 7b, and 8a, are critically misaligned (ratio difference ranges from 0.015 to 0.035), (c) with respect to skills subcategory, the topics 2a, 3a, 3b, 4c, and 6b are critically misaligned (ratio difference ranges from 0.006 to 0.016), and (d) with respect to STS Connection subcategory, the topics 1a, 3a, 3b, 3c, 4d, and 8a are critically misaligned (ratio difference ranges from 0.011 to 0.016).

The misalignment between the question papers Grade IX administered by BISE (M) and the written curriculum at fine grain level is because question papers do not consist of items relating to different categories of cognitive demand in the ratio they are given in the written curriculum.

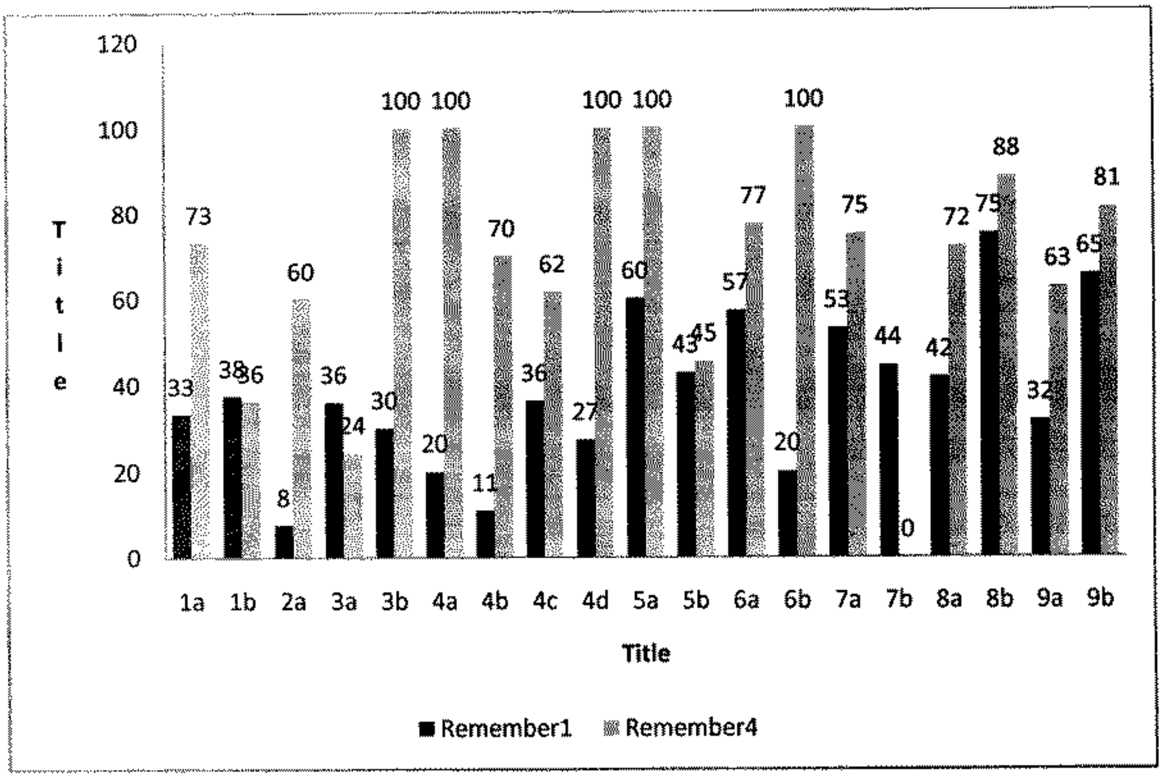

Figure 4.25. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (M): Fine Grain Level- Subcategory Remember *(1=Written Curriculum, 4=Question Papers)*

Figure 4.25 compares written curriculum and question papers (Grade-IX) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (M) and the written curriculum. Moreover, except topics 1b and 3a, question papers (Grade-IX) from BISE (M) give more emphasis to the remember subcategory than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 20%) in topics 1b, 3a, 5b, 6a, 8b, and 9b, and maximum (ranges from 35% to 75%) in topics 1a, 2a, 3b, 4a, 4b, and 6a. Moreover, all the items relating to topics 3b, 4a, 4b, and 6a in question papers (Grade-X) from BISE (M) are about the remember subcategory contrary to that of given in the written curriculum.

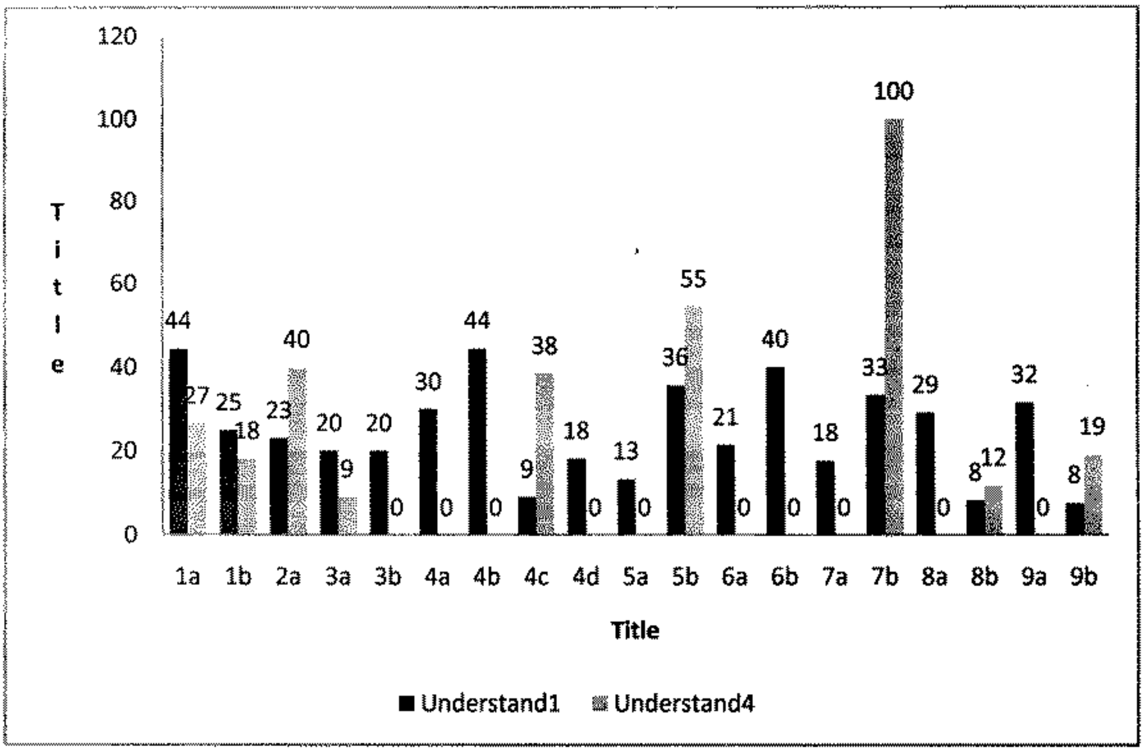

Figure 4.26. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (M): Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 4=Question Papers)*

Figure 4.26 compares written curriculum and question papers (Grade-IX) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (M) and the written curriculum. Moreover, question papers from BISE (M) do not contain even a single item with respect to understand subcategory from most of topics (53% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 15%) in topics 1b, 3a, 8b, and 9b, and maximum (ranges from 40% to 67%) in topics 4a 6b, and 7b.

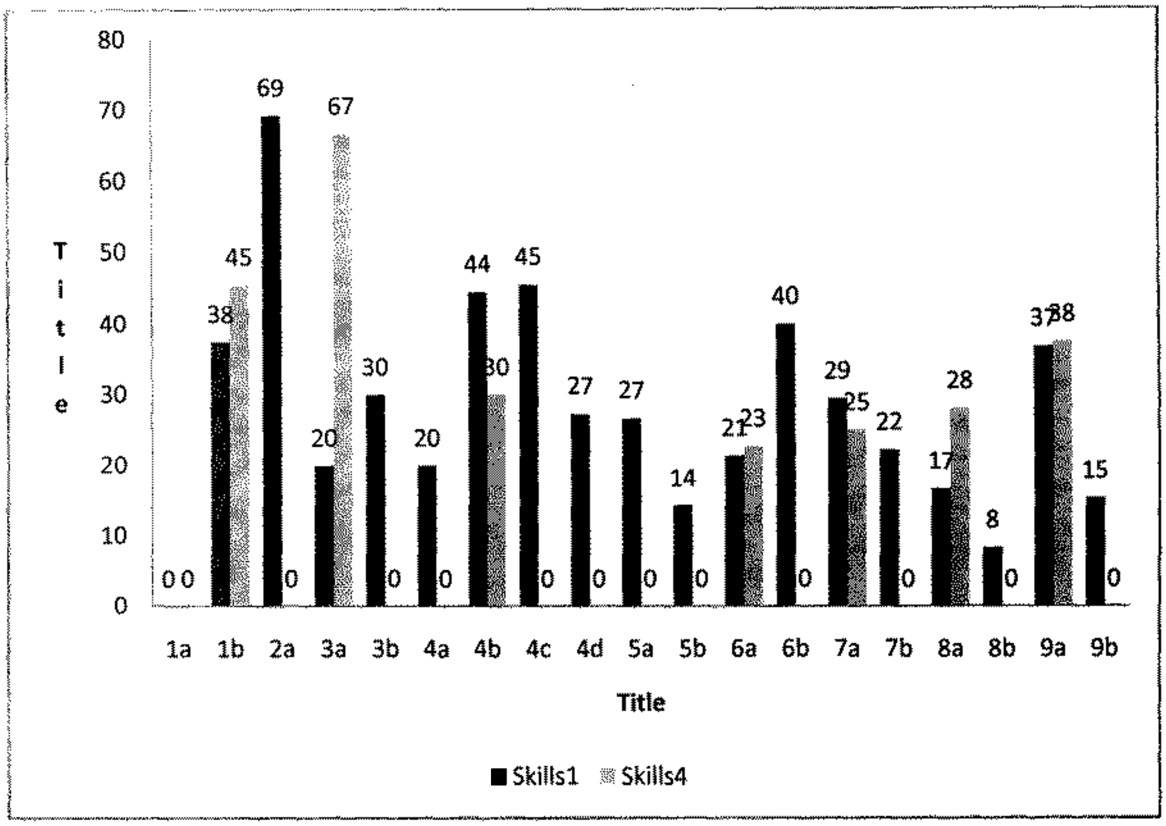

Figure 4.27. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (M): Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers)*

Figure 4.27 compares written curriculum and question papers (Grade-IX) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade IX) from BISE (M) and the written curriculum. Moreover, question papers (Grade IX) from BISE (M) do not contain even a single item with respect to Skills subcategory from most of the topics (58% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 18%) in topics 1b, 4b, 6a, 7a, 8a, and 9b, and maximum (ranges from 40% to 69%) in topics 2a, 3a, 4c, and 6b.

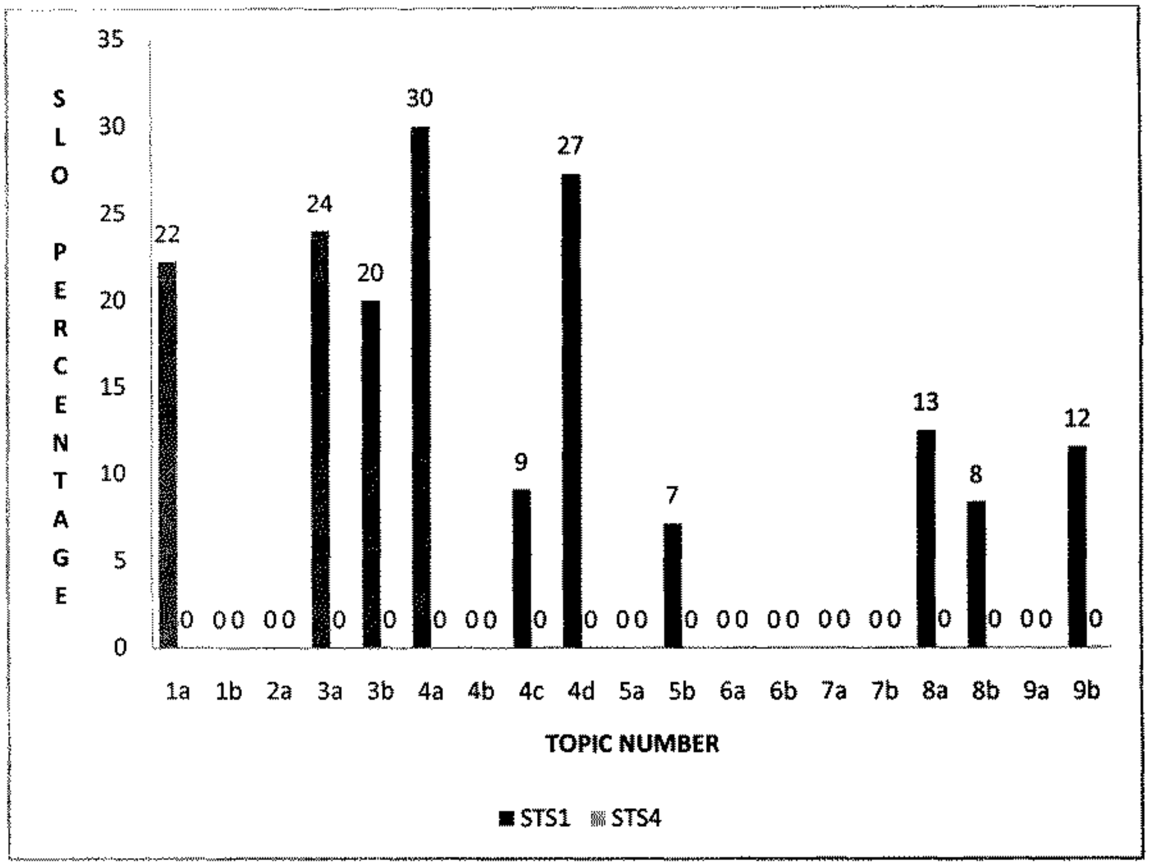

Figure 4.28. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (M): Fine Grain Level- Subcategory STS Connection *(1=Written Curriculum, 4=Question Papers)*

Figure 4.28 compares written curriculum and question papers (Grade-IX) by BISE (M) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade IX) from BISE (M) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade IX) from the BISE (M) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 7% to 30%) consists of subcategory of STS Connection.

Table 4.10

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE M (Grade X)

Topic Number	Ratio Difference with respect to				
	Remember14	Understand14	Skills14	STS14	Subtotal
10a	0.003	0.020	0.020	0.003	**0.047**
10b	0.018	0.000	0.008	0.026	**0.053**
11a	0.013	0.007	0.021	0.000	**0.041**
11b	0.006	0.001	0.001	0.006	**0.015**
12a	0.025	0.005	0.014	0.007	**0.051**
12b	0.036	0.012	0.012	0.012	**0.071**
12c	0.035	0.013	0.004	0.017	**0.069**
13a	0.002	0.004	0.004	0.006	**0.015**
13b	0.019	0.034	0.011	0.005	**0.069**
13c	0.036	0.024	0.000	0.012	**0.071**
14a	0.001	0.001	0.013	0.012	**0.027**
14b	0.026	0.004	0.022	0.000	**0.052**
14c	0.001	0.010	0.019	0.009	**0.039**
15a	0.020	0.002	0.004	0.018	**0.044**
15b	0.031	0.009	0.013	0.009	**0.063**
16a	0.003	0.008	0.007	0.003	**0.020**
16b	0.040	0.017	0.010	0.014	**0.081**
17a	0.003	0.002	0.005	0.000	**0.011**
17b	0.016	0.000	0.000	0.016	**0.032**
18a	0.018	0.022	0.000	0.004	**0.043**
18b	0.040	0.024	0.000	0.016	**0.079**
Total	**0.391**	**0.219**	**0.187**	**0.197**	**0.993**
	Alignment Index				**0.50**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.10 shows alignment of written curriculum with question papers by BISE (M) Grade X at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (M) Grade X at fine grain level is 0.50 which reflects a significant misalignment level. This misalignment is spread across the topics as well as subcategories. The topics 10b, 12a, 12b, 12c, 13b, 13c, 14b, 15b, 16b, and 18b (sum of ratio difference ranges from 0.051 to 0.081) and subcategories Remember, Understand and STS connection (sum of ratio difference ranges from 0.197 to 0.391) are misaligned to the critical level. Similarly, topics 10a, 11a, 14c, 15a, and 18a (sum of ratio difference ranges from 0.039 to 0.047) and subcategory Skills (sum of ratio difference is 0.0.187) are significantly misaligned.

The individual ratio differences show that there is critical misalignment (a) with respect to Remember subcategory, the topics 12a, 12b, 12c, 13b, 13c, 14b, 15a, 15b, 16b, and 18b (ratio difference ranges from 0.020 to 0.040), (b) with respect to Understand subcategory, the topics 10a, 12b, 12c, 13b, 13c, 16b, 18a, and 18b (ratio difference ranges from 0.012 to 0.034), (c) with respect to Skills subcategory, the topics 10a, 11a, 11b, 12a, 12b, 14a, 14b, 14c, and 15b (ratio difference ranges from 0.012 to 0.022), and (d) with respect to STS Connection subcategory, the topics 10b, 12b, 12c, 13c, 14a, 16b, 17b and 18b (ratio difference ranges from 0.012 to 0.026).

The misalignment between the question papers Grade X administered by BISE (N) and the written curriculum is because of unmatched distribution of items with respect to SLO of different categories. Unlike suggestions in the written curriculum, question papers contain more items relating to Remember subcategory, less items relating to Understand subcategory and no items relating to STS Connection subcategory. This trend is same as that of textbooks.

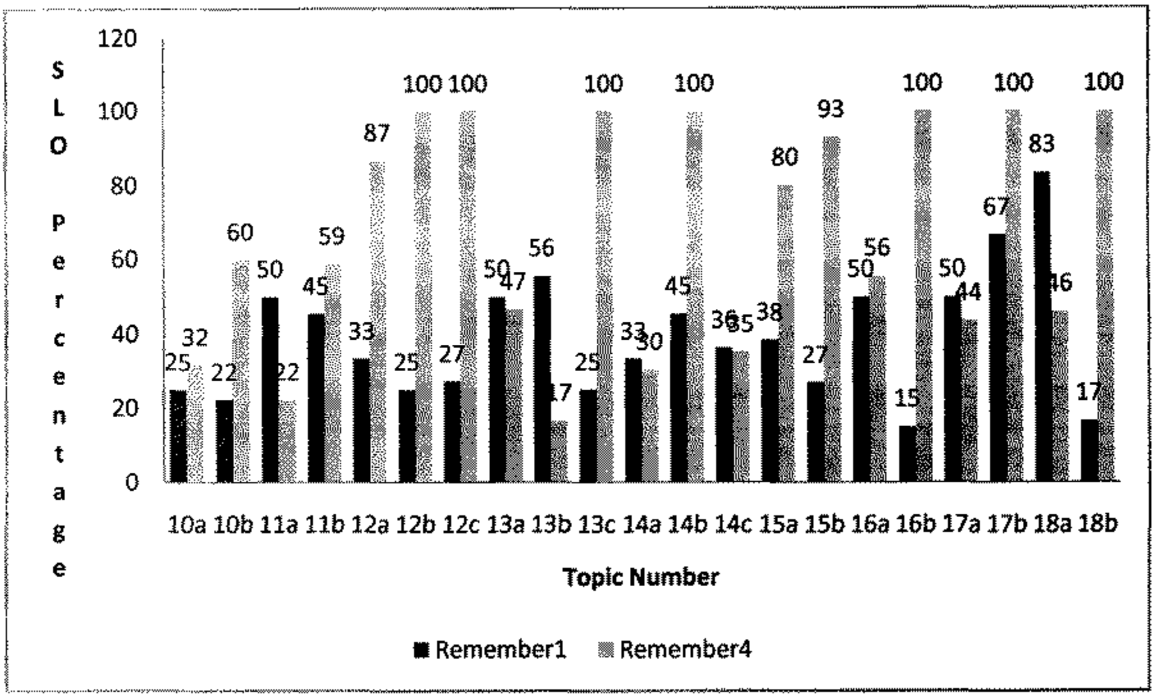

Figure 4.29. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (M): Fine Grain Level- Subcategory Remember (*1=Written Curriculum, 4=Question Papers)*

Figure 4.29 compares written curriculum and question papers (Grade-X) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (M) and the written curriculum. Moreover, mostly question papers (Grade-X) from BISE (M) give more emphasis to the remember subcategory than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 20%) in topics 10a, 11b, 13a, 14a, 14c, 16a, and 17a, and maximum (ranges from 35% to 85%) in topics 12a, 12b, 12c, 13c, 15a, 15b, 16b, and 18b. Moreover, all the items relating to topics 11b, 12a, 12b, 12c, 13c, 14b, 16b, 17b, and 18b in question papers (Grade-X) from BISE (M) are only about the remember subcategory contrary to that of given in the written curriculum.

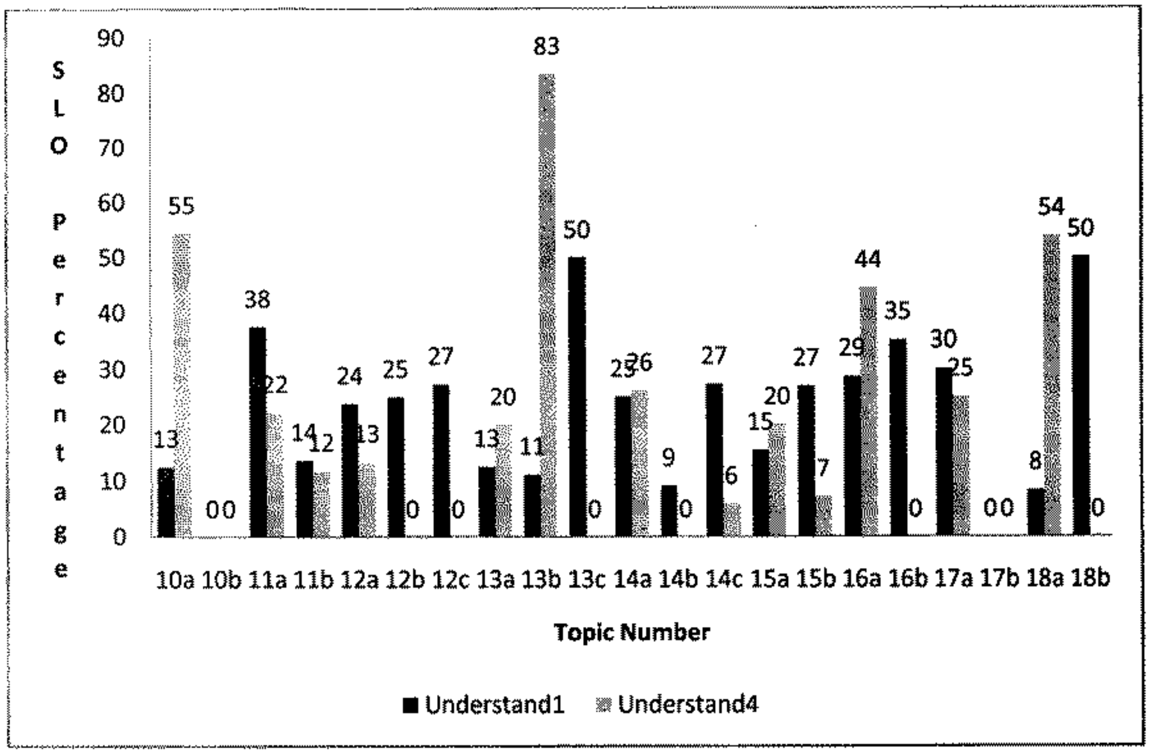

Figure 4.30. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (M): Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 4=Question Papers)*

Figure 4.30 compares written curriculum and question papers (Grade-X) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (M) and the written curriculum. Moreover, question papers from BISE (M) do not contain even a single item with respect to understand subcategory from many the topics (26% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 15%) in topics 11b, 12a, 13a, 14a, 15b, 16a, and 17a, and maximum (ranges from 33% to 72%) in topics 10a, 13b, 13c, 18a, and 18b.

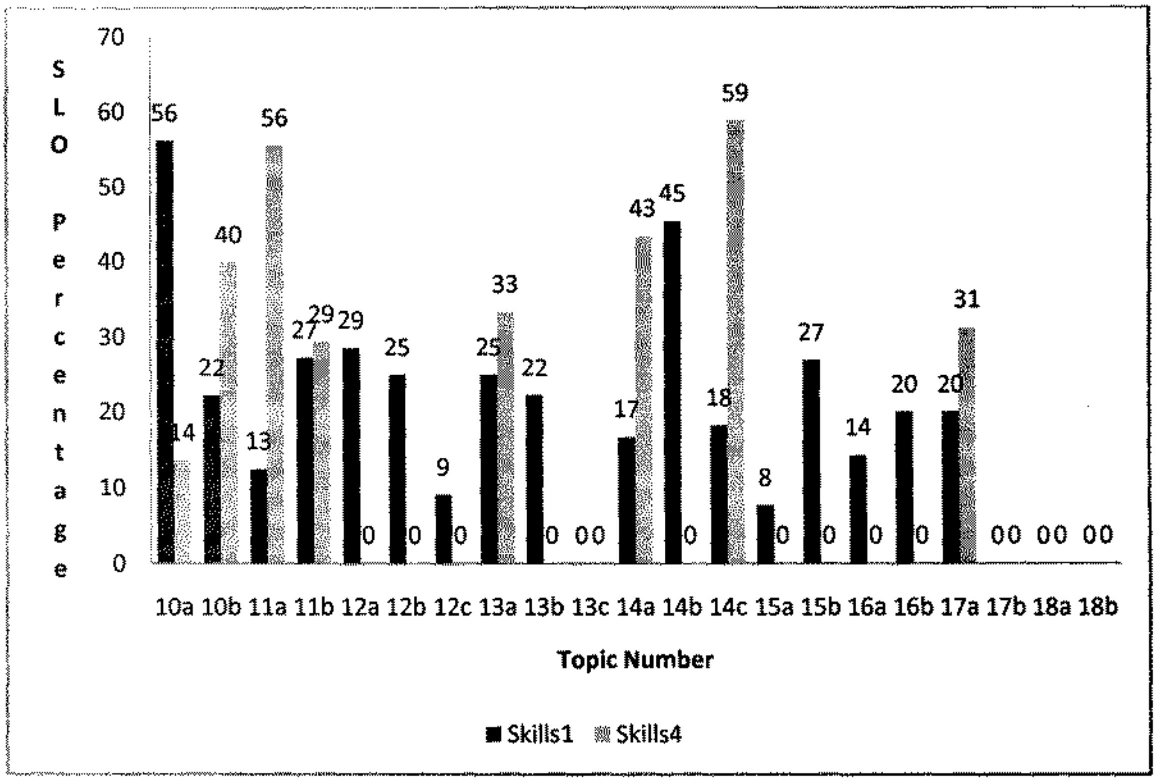

Figure 4.31. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (M): Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers)*

Figure 4.31 compares written curriculum and question papers (Grade-X) by BISE (M) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade X) from BISE (M) and the written curriculum. Moreover, question papers (Grade X) from BISE (M) do not contain even a single item with respect to Skills subcategory from many topics (44% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 8% to 18%) in topics 11b, 13a, and 17a, and maximum (ranges from 26% to 45%) in topics 10a, 11a, 14a, 14b, and 14c.

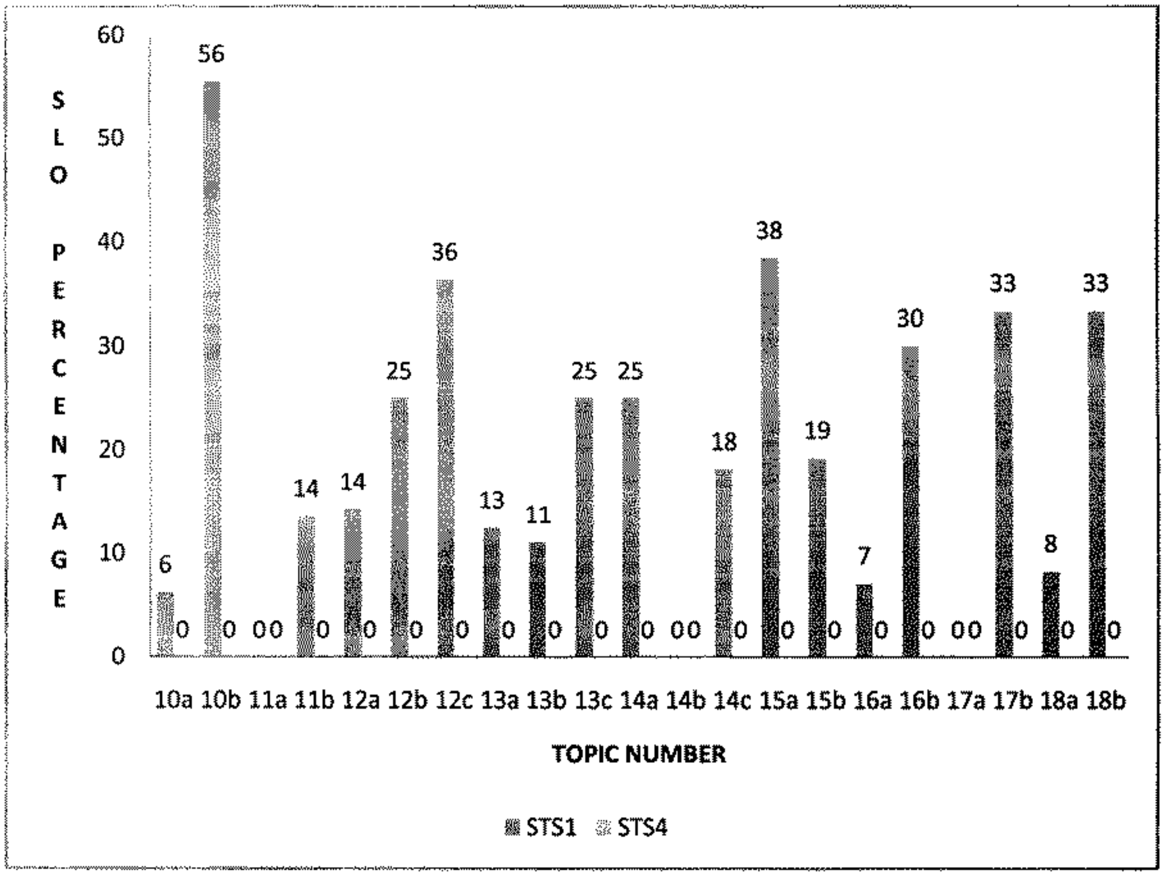

Figure 4.32. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (M): Fine Grain Level- Subcategory STS Connection (*1=Written Curriculum, 4=Question Papers)*

Figure 4.32 compares written curriculum and question papers (Grade-X) by BISE (M) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (M) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade-X) from the BISE (M) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 7% to 56%) consists of subcategory of STS Connection.

Table 4.11

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE N (Grade IX)

Topic Number	Ratio Difference with respect to				
	Remember14	Understand14	Skills14	STS14	Total
1a	0.030	0.018	0.000	0.012	**0.060**
1b	0.010	0.010	0.020	0.000	**0.039**
2a	0.034	0.012	0.022	0.000	**0.068**
3a	0.002	0.008	0.003	0.013	**0.025**
3b	0.037	0.011	0.016	0.011	**0.074**
4a	0.042	0.016	0.011	0.016	**0.084**
4b	0.034	0.010	0.023	0.000	**0.067**
4c	0.020	0.008	0.024	0.005	**0.057**
4d	0.007	0.022	0.014	0.014	**0.057**
5a	0.005	0.019	0.014	0.000	**0.039**
5b	0.004	0.008	0.008	0.004	**0.023**
6a	0.013	0.011	0.002	0.000	**0.027**
6b	0.042	0.021	0.021	0.000	**0.084**
7a	0.004	0.005	0.008	0.000	**0.017**
7b	0.004	0.003	0.007	0.000	**0.015**
8a	0.007	0.014	0.014	0.007	**0.041**
8b	0.004	0.004	0.005	0.004	**0.018**
9a	0.021	0.017	0.005	0.000	**0.043**
9b	0.011	0.003	0.008	0.006	**0.028**
Total	**0.331**	**0.220**	**0.224**	**0.091**	**0.865**
		Alignment Index			**0.57**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.11 shows alignment of written curriculum with question papers by BISE (N) Grade IX at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (N) Grade IX at fine grain level is 0.57 which reflects a significant misalignment level. This misalignment is spread across the topics as well as subcategories. The topics 1a, 2a, 3b, 4a, 4b, 4c, 4d, and 6b (sum of ratio difference ranges from 0.057 to 0.084) and subcategory STS connection (sum of ratio difference is 0.091) are misaligned to the critical level. Similarly, topic 9a (sum of ratio difference is 0.043) and subcategories Remember, Understand and Skills (sums of ratio difference are 0.331, 0.220 and 0.224) are significantly misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 1a, 2a, 3b, 4a, 4b, and 6b are critically misaligned (ratio difference ranges from 0.030 to 0.042), (b) with respect to Understand subcategory, the topics 1a, 4a,4d, 5a, 6b, 8a, and 9a, are critically misaligned (ratio difference ranges from 0.014 to 0.022), (c) with respect to skills subcategory, the topics 1b, 2a, 3a, 3b, 4c, and 6b are critically misaligned (ratio difference ranges from 0.016 to 0.024), and (d) with respect to STS Connection subcategory, the topics 1a, 3a, 3b, 3c, 4d, 8a, and 9b are critically misaligned (ratio difference ranges from 0.006 to 0.016).

The question papers Grade IX administered by BISE (N) do not cover SLO relating to different categories of cognitive demand as proposed in the written curriculum. Mostly the items relate to Remember subcategory. There are also items relating to Understand subcategory but these are fewer. These are causing lack of alignment between the question papers Grade IX administered by BISE (N) and the written curriculum at fine grain level.

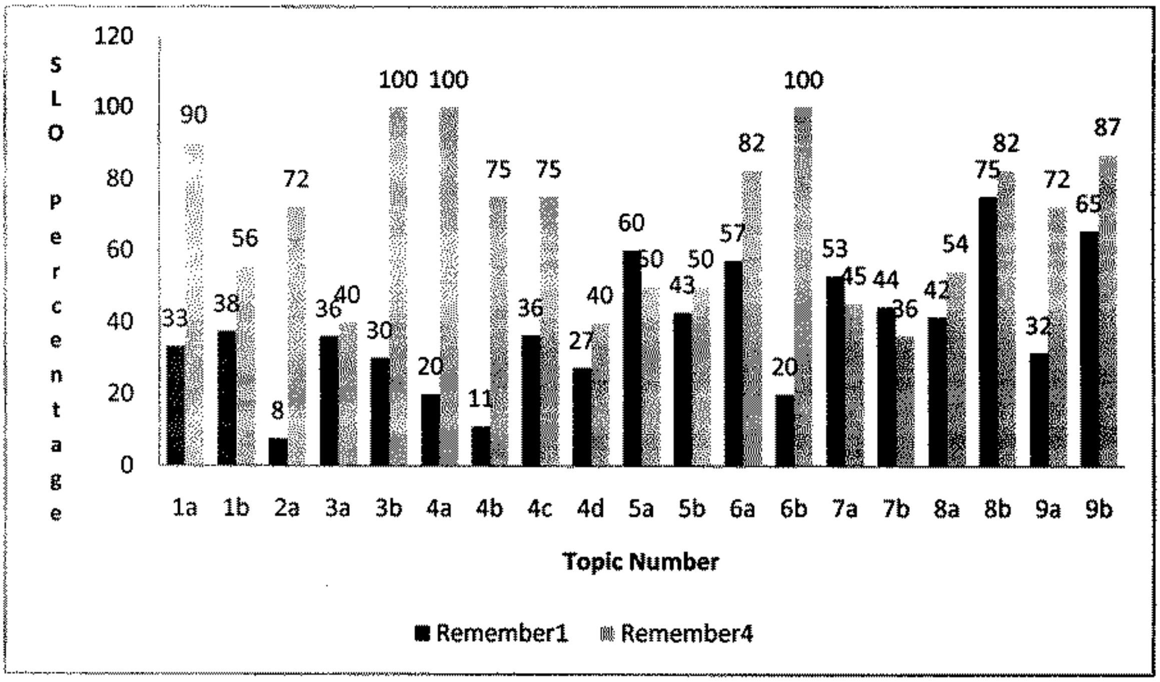

Figure 4.33. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (N): Fine Grain Level- Subcategory Remember (*1=Written Curriculum, 4=Question Papers)*

Figure 4.33 compares written curriculum and question papers (Grade-IX) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (N) and the written curriculum. Moreover, except topics 7a and 7b, SLO percentage of the question papers (Grade-IX) from BISE (N) for the remember subcategory is higher than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 4% to 20%) in topics 1b, 3a, 4d, 5a, 5b, 7a, 7b, 8a, and 8b, and maximum (ranges from 35% to 80%) in topics 1a, 2a, 3b, 4a, 4b, 4c, 6b, and 9a. Moreover, all the items relating to topics 3b, 4a, and 6a in question papers (Grade-IX) from BISE (N) are about the remember subcategory contrary to that of given in the written curriculum.

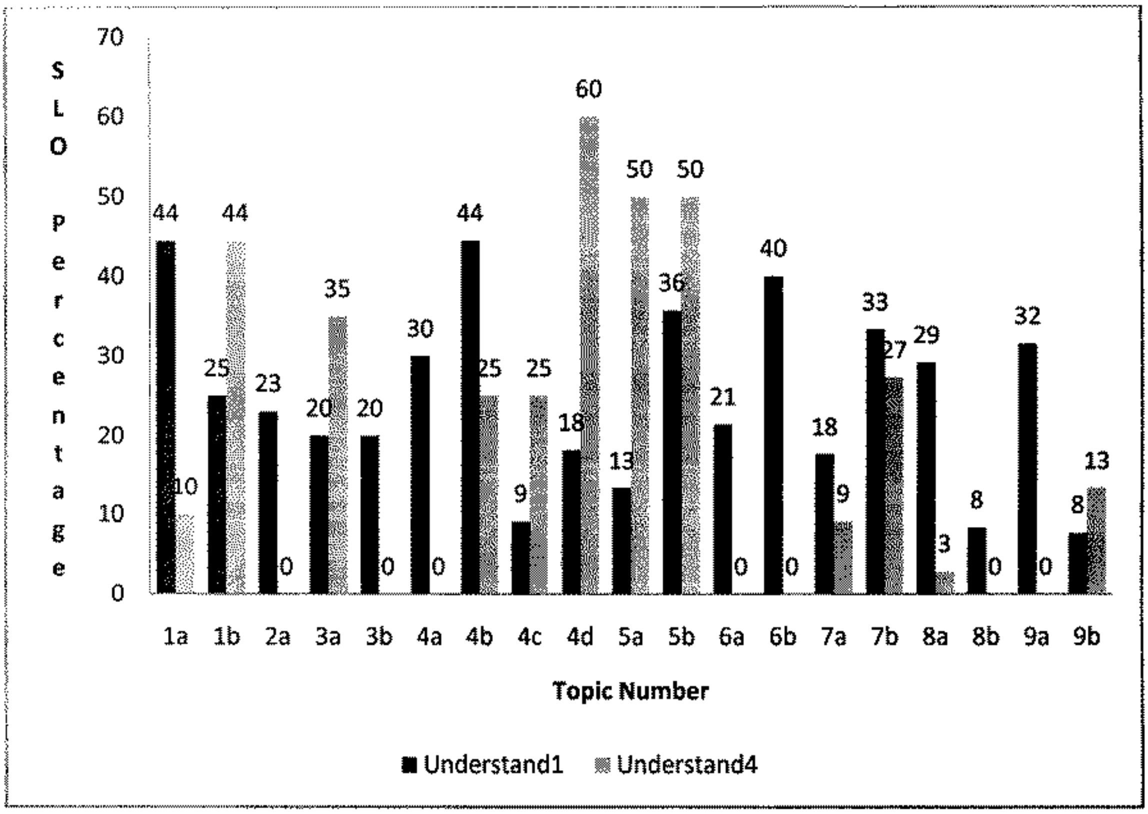

Figure 4.34. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (N): Fine Grain Level- Subcategory Understand (*1=Written Curriculum, 4=Question Papers)*

Figure 4.34 compares written curriculum and question papers (Grade-IX) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (N) and the written curriculum. Moreover, question papers from BISE (N) do not contain even a single item with respect to understand subcategory from many topics (32% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 5% to 15%) in topics 3a, 5b, 7a, 7b, and 9b, and maximum (ranges from 34% to 42%) in topics 1a, 4d, 5a, and 6b.

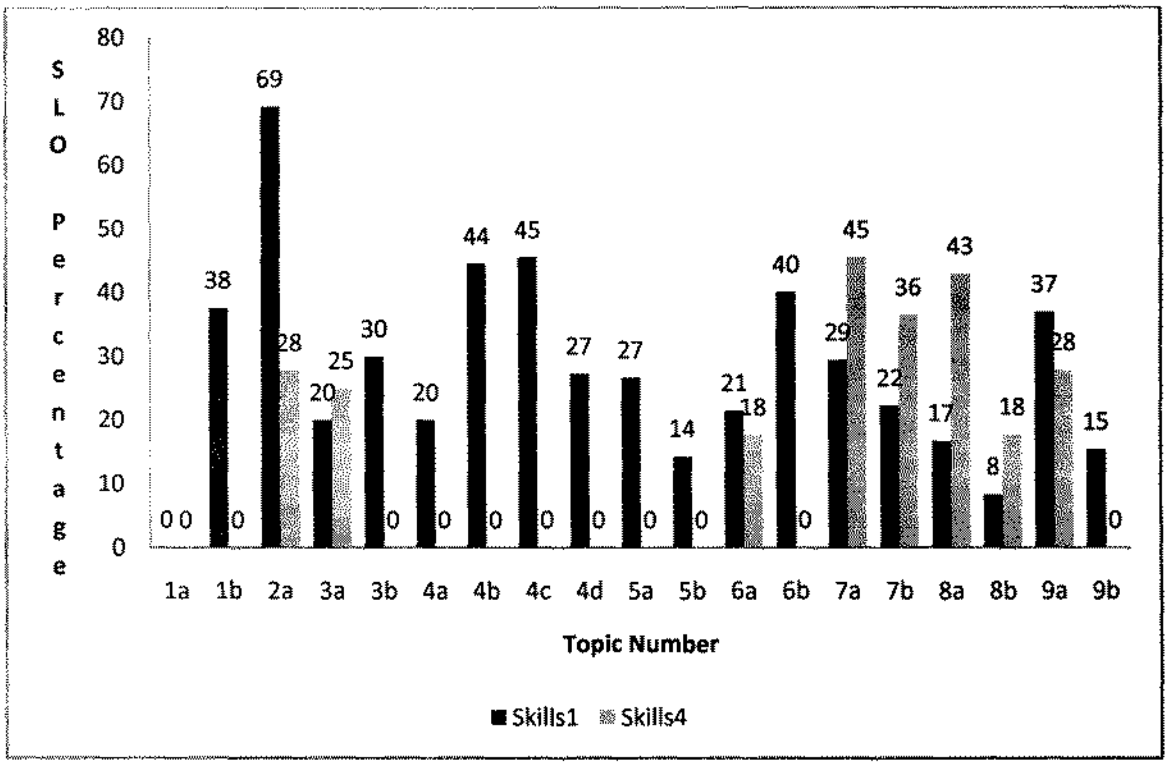

Figure 4.35. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (N): Fine Grain Level- Subcategory Skills (*1=Written Curriculum, 4=Question Papers)*

Figure 4.35 compares written curriculum and question papers (Grade-IX) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade IX) from BISE (N) and the written curriculum. Moreover, question papers (Grade IX) from BISE (N) do not contain even a single item with respect to Skills subcategory from most of the topics (56% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 3% to 15%) in topics 3a, 6a, 7b, 8b, and 9a, and maximum (ranges from 40% to 45%) in topics 2a, 4b, 4c, and 6b.

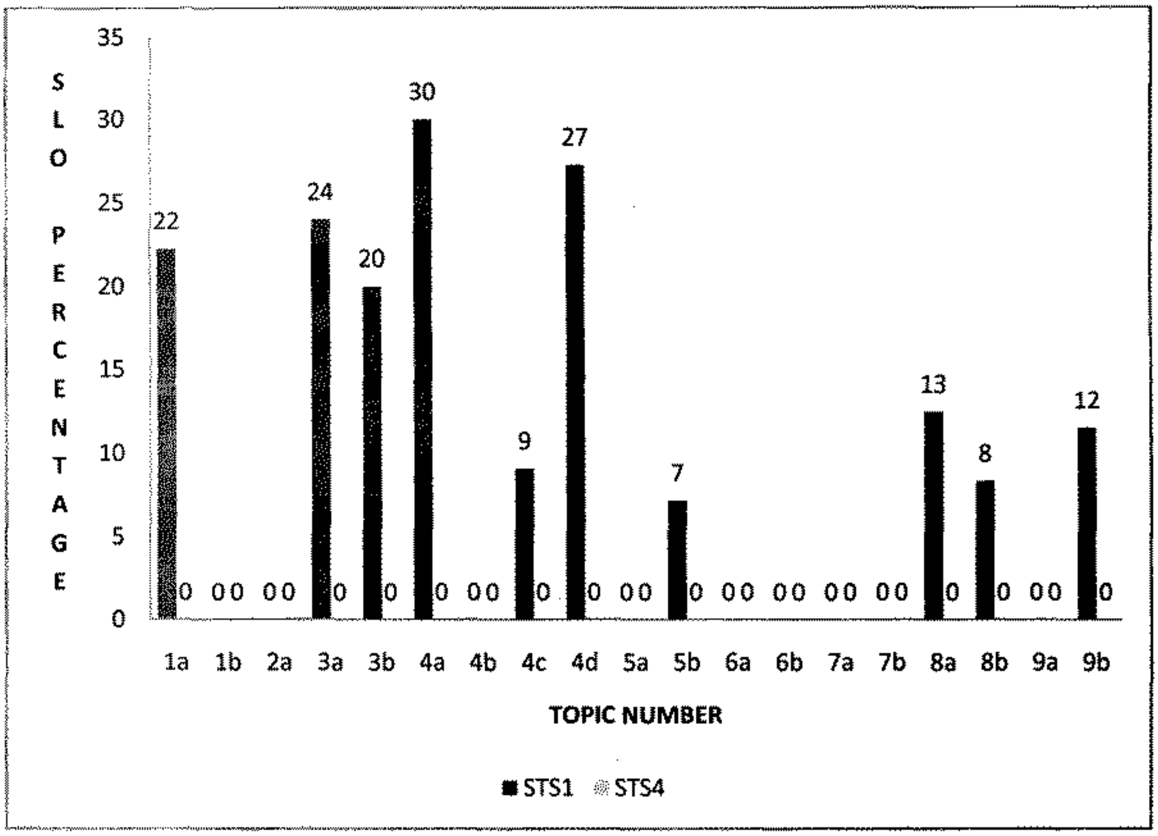

Figure 4.36. Comparison of Written Curriculum and the Question Papers (Grade IX) by BISE (N): Fine Grain Level- Subcategory STS Connection *(1=Written Curriculum, 4=Question Papers)*

Figure 4.36 compares written curriculum and question papers (Grade-IX) by BISE (N) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-IX) from BISE (N) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade-IX) from the BISE (N) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 7% to 30%) consists of subcategory of STS Connection.

Table 4.12

Fine Grain Level Alignment of Written Curriculum with Question Papers by BISE N (Grade X)

Topic Number	Ratio Difference with respect to				
	Remember14	**Understand14**	**Skills14**	**STS14**	**Subtotal**
10a	0.008	0.015	0.027	0.003	**0.052**
10b	0.011	0.000	0.011	0.026	0.048
11a	0.024	0.018	0.006	0.000	0.048
11b	0.022	0.006	0.013	0.006	0.048
12a	0.004	0.011	0.014	0.007	0.036
12b	0.012	0.012	0.012	0.012	0.048
12c	0.013	0.013	0.004	0.017	0.048
13a	0.016	0.024	0.012	0.006	**0.058**
13b	0.017	0.005	0.011	0.005	0.038
13c	0.012	0.024	0.000	0.012	0.048
14a	0.003	0.001	0.008	0.012	0.024
14b	0.015	0.024	0.022	0.000	**0.061**
14c	0.004	0.002	0.009	0.009	0.024
15a	0.011	0.007	0.004	0.018	0.040
15b	0.022	0.013	0.013	0.009	**0.057**
16a	0.013	0.005	0.007	0.003	0.028
16b	0.006	0.017	0.010	0.014	0.046
17a	0.024	0.014	0.010	0.000	0.048
17b	0.013	0.000	0.000	0.016	0.029
18a	0.025	0.004	0.000	0.004	0.033
18b	0.008	0.024	0.000	0.016	0.048
Total	**0.280**	**0.239**	**0.189**	**0.197**	**0.905**
	Alignment Index				**0.55**

Note: 14= Between Written Curriculum and Question Papers, STS=STS Connection

Table 4.12 shows alignment of written curriculum with question papers by BISE (N) Grade X at fine grain level. It shows that the alignment index between written curriculum and question papers by BISE (N) Grade X at fine grain level is 0.50 which reflects a significant misalignment level. This misalignment is spread across the topics as well as subcategories. The topics 10a, 13a, 14b, and 15b (sum of ratio difference ranges from 0.052 to 0.061) and subcategories Understand and STS connection (sum of ratio difference are 0.239 and 0.197 respectively) are misaligned to the critical level. Similarly, topics 10b, 11a, 11b, 12b, 12c, 15a, 16b, 17a, and 18b (sum of ratio difference ranges from 0.040 to 0.048) subcategory Skills (sum of ratio difference is 0.0.189) are significantly misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the topics 11a, 11b, 15b, 17a, and18a (difference ranges from 0.022 to 0.025), (b) with respect to Understand subcategory, the topics 10a, 10b, 11b, 12a, 12b, 12c, 13a, 13c, 14b, 15b, 16b, and 17a are critically misaligned (ratio difference ranges from 0.011 to 0.024), (c) with respect to Skills subcategory, the topics 10a, 10b, 11b, 12a, 12b, 13a, 13b, and 14b are critically misaligned (ratio difference ranges from 0.011 to 0.027), and (d) with respect to STS Connection subcategory, the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b and 18b are critically misaligned (ratio difference ranges from 0.012 to 0.026).

The misalignment between the question papers Grade X administered by BISE (N) and the written curriculum at fine grain level is because distribution of items with respect to subcategories of cognitive demand do not match the written curriculum. Unlike the written curriculum, in question papers there are more items for Remember subcategory and fewer items for all other subcategories.

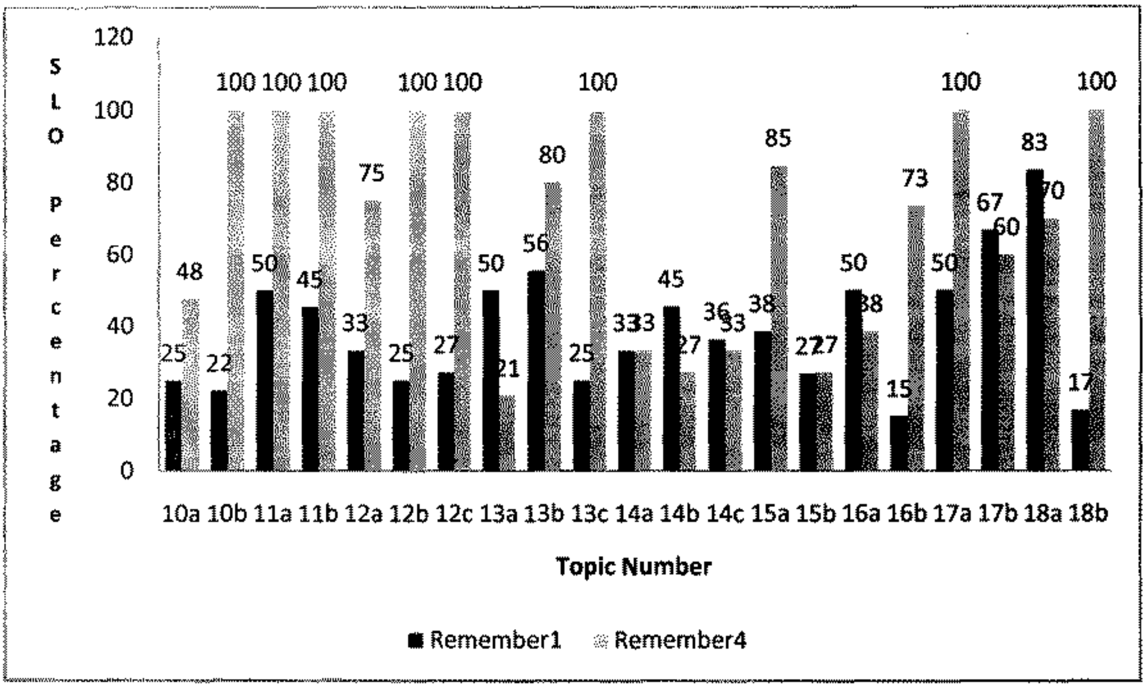

Figure 4.37 Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (N): Coarse Grain level- Subcategory Remember (*1=Written Curriculum, 4=Question Papers)*

Figure 4.37 compares written curriculum and question papers (Grade-X) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Remember. It shows that, except topics 14a and 15b, there is no topic in which there is complete alignment between the question papers (Grade-X) from BISE (N) and the written curriculum. Moreover, mostly question papers (Grade-X) from BISE (N) give more emphasis to the remember subcategory than that of given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 3% to 20%) in topics 13b, 14b, 14c, 16a, 17b and 18a, and maximum (ranges from 35% to 83%) in topics 10b, 11a, 12a, 12b, 12c, 13c, 15a, 16b, 17a, and 18b. Moreover, all the items relating to topics 10b, 11a, 11b, 12b, 12c, 13c, 17a, and 18b in question papers (Grade-X) from BISE (N) are only about the remember subcategory contrary to that of given in the written curriculum.

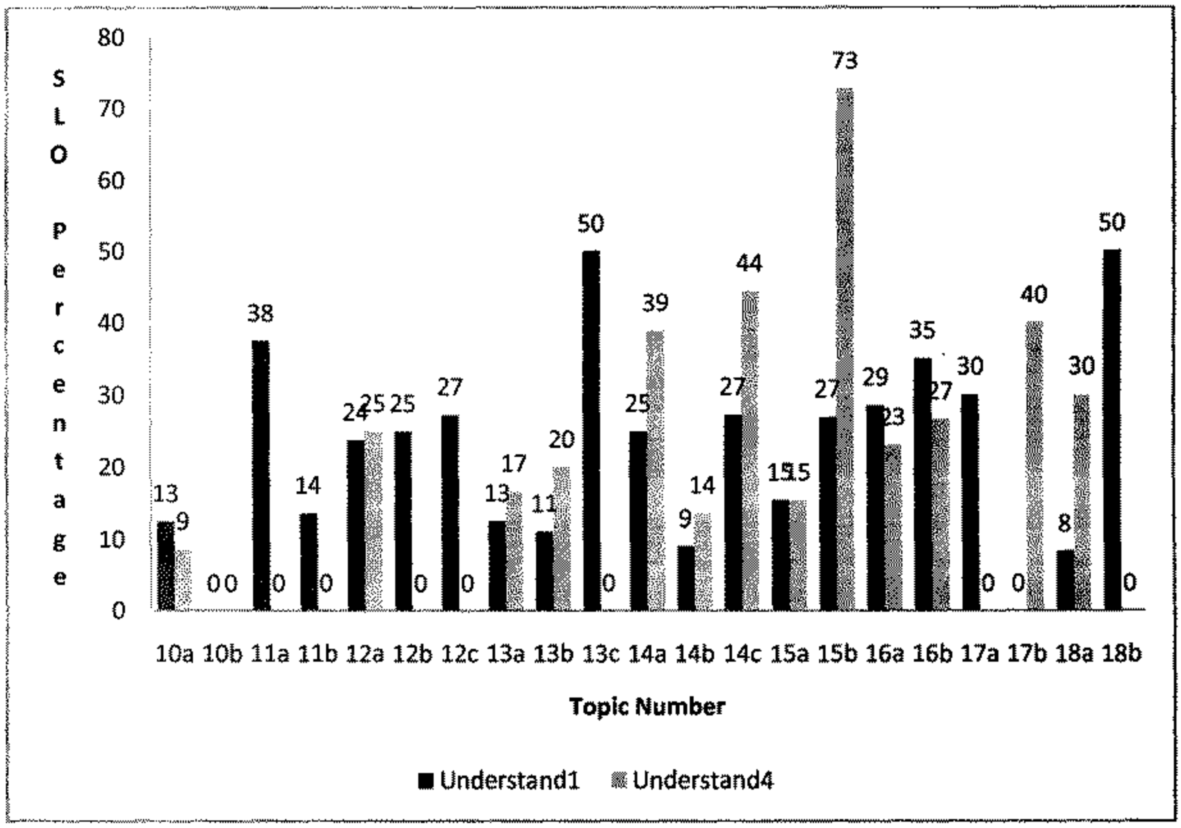

Figure 4.38. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (N): Fine Grain Level- Subcategory Understand *(1=Written Curriculum, 4=Question Papers)*

Figure 4.38 compares written curriculum and question papers (Grade-X) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Understand. It shows that, except topic 15a, there is no topic in which there is complete alignment between the question papers (Grade-X) from BISE (N) and the written curriculum. Moreover, question papers from BISE (N) do not contain even a single item with respect to understand subcategory from many the topics (37% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 2% to 15%) in topics 10a, 12a, 13a, 13b, 14a, 14b, 16a, and 16b, and maximum (ranges from 33% to 50%) in topics 11a, 13c, 15b, 17b, and 18b.

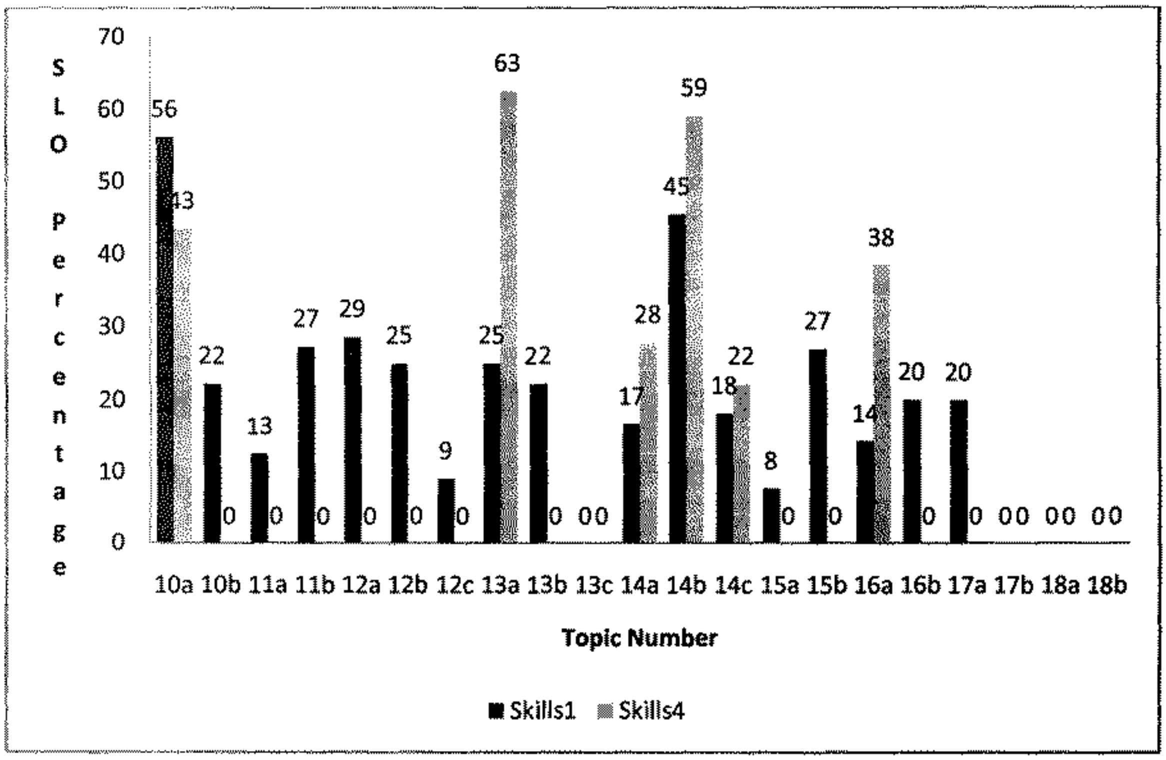

Figure 4.39. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (N): Fine Grain Level- Subcategory Skills *(1=Written Curriculum, 4=Question Papers)*

Figure 4.39 compares written curriculum and question papers (Grade-X) by BISE (N) at fine grain level with respect to cognitive demand's subcategory Skills. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade X) from BISE (N) and the written curriculum. Moreover, question papers (Grade X) from BISE (N) do not contain even a single item with respect to Skills subcategory from most of topics (65% topics) contrary to prescription given in the written curriculum. However, the difference of SLO percentage varies across the topics. This difference of SLO percentage is comparatively less (ranges from 8% to 15%) in topics 10a, 14a, 14b, and 14c, and maximum (ranges from 26% to 38%) in topics 11b, 12a, 13a, and 15b.

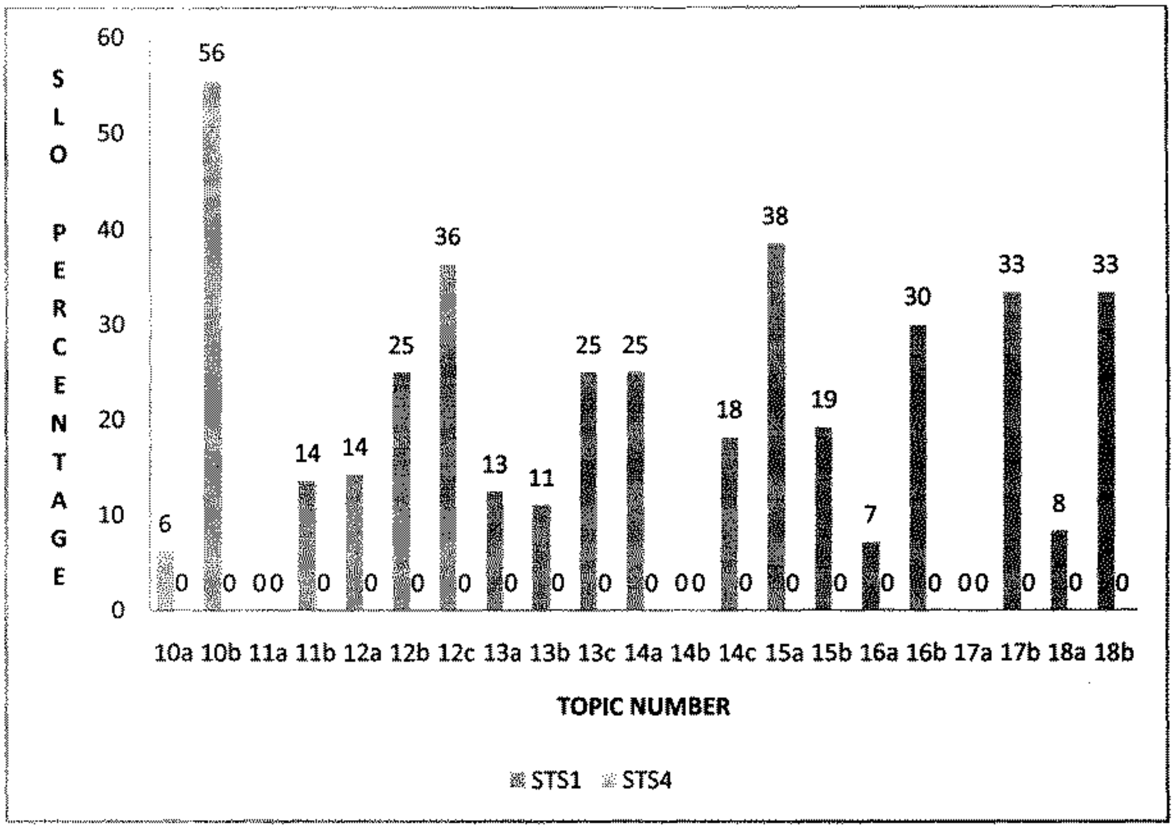

Figure 4.40. Comparison of Written Curriculum and the Question Papers (Grade X) by BISE (N): Fine Grain Level- Subcategory STS Connection *(1=Written Curriculum, 4=Question Papers)*

Figure 4.40 compares written curriculum and question papers (Grade-X) by BISE (N) at fine grain level with respect to cognitive demand's subcategory STS Connection. It shows that there is not a single topic in which there is complete alignment between the question papers (Grade-X) from BISE (N) and the written curriculum at fine grain level with respect to cognitive demand's subcategory STS Connection. Moreover, question papers (Grade-X) from the BISE (N) consist of no item with respect to cognitive demand's subcategory STS Connection. On the other hand, in written curriculum considerable SLOs percentage (ranges from 7% to 56%) consists of subcategory of STS Connection.

Table 4.13

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group W1)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.055	0.009	0.025	0.022	**0.111**
B	0.042	0.016	0.021	0.005	0.083
C	0.026	0.007	0.001	0.020	0.055
D	0.038	0.010	0.002	0.030	0.080
E	0.063	0.027	0.009	0.027	**0.127**
F	0.023	0.011	0.013	0.025	0.071
Total	**0.247**	**0.080**	**0.039**	**0.128**	**0.526**
		Alignment Index			**0.74**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.13 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group W1). It shows that the alignment index between written curriculum and the curriculum taught by Teacher (Group W1) at coarse grain level is 0.74 which reflects a considerable level of alignment. However, this alignment is not spread across all sections as well as subcategories of cognitive demand. For example, the subcategory STS connection (sum of ratio difference is 0.128) is significantly misaligned. Similarly, sections A and E (sums of ratio difference are 0.111 and 0.127) and subcategory Remember (sum of ratio difference is 0.247) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the sections A, and E are significantly misaligned (ratio difference ranges from 0.055 to 0.063), and (b) with respect to STS Connection subcategory, sections D, E, and F are critically misaligned (ratio difference ranges from 0.020 to 0.030).

More Sections (B, C, D, & F) are aligned because instruction follows the pattern of written curriculum. However, the misalignment in sections A and E is because instruction is limited to SLO relating to Remember subcategory. Consequently, SLO relating to Understand and STS Connection subcategories have been ignored. Therefore, less emphasis on Remember subcategory and more emphasis on Understand and STS Connection subcategories are required for good alignment between the taught and written curricula.

Table 4.14

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group W2)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.070	0.012	0.035	0.023	**0.140**
B	0.049	0.006	0.036	0.008	0.098
C	0.046	0.008	0.017	0.021	0.093
D	0.041	0.012	0.002	0.031	0.086
E	0.073	0.029	0.015	0.029	**0.147**
F	0.013	0.003	0.011	0.026	0.053
Total	**0.292**	**0.064**	**0.090**	**0.139**	**0.615**
		Alignment Index			**0.69**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.14 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group W2). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group W2) at coarse grain level is 0.69 which reflects a considerable level of misalignment. Moreover, this misalignment is spread across all sections as well as subcategories of cognitive demand. For example, the subcategory STS connection (sum of ratio difference is 0.139) is significantly misaligned. Similarly, sections A and E (sums of ratio difference are 0.140 and 0.147) and subcategory Remember (sum of ratio difference is 0.292) are considerably misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the sections A, and E are critically misaligned (sum of ratio difference ranges from 0.070 to 0.073), (b) with respect to subcategory Skills, sections A and B are significantly misaligned (ratio differences were 0.035 and 0.036 respectively), and (c) with respect to STS Connection subcategory, sections D, E, and F are critically misaligned (ratio difference ranges from 0.026 to 0.031).

Misalignment between written curriculum and the curriculum taught by Teachers (Group W2) at coarse grain level, particularly in sections A and E, is because instruction is limited to SLO relating to Remember subcategory. Consequently, SLO relating to Understand category and STS Connection subcategory have been ignored. Therefore, less emphasis on Remember subcategory and more emphasis on Understand and STS Connection subcategories are required for good alignment between the taught and written curricula.

Table 4.15

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group W3)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.092	0.020	0.048	0.024	**0.185**
B	0.069	0.020	0.040	0.009	**0.138**
C	0.061	0.019	0.020	0.022	**0.123**
D	0.065	0.013	0.019	0.032	**0.130**
E	0.082	0.027	0.022	0.033	**0.164**
F	0.042	0.010	0.004	0.028	0.083
Total	**0.411**	**0.109**	**0.154**	**0.148**	**0.822**
		Alignment Index			**0.59**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.15 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group W3). It shows that the alignment index between written and taught curricula at coarse grain level is 0.59 which reflects a significant level of misalignment. Moreover, this misalignment is not spread across all sections as well as subcategories of cognitive demand. For example, the subcategories Remember and STS connection (sums of ratio difference are 0.411 and 0.139 respectively) are critically misaligned. Similarly, sections B and E (sums of ratio difference are 0.138 and 0.164) are significantly misaligned.

The individual ratio differences show that (a) with respect to Remember subcategory, the sections A, B and E are critically misaligned (sum of ratio difference ranges from 0.069 to 0.092), (b) with respect to subcategory Skills, section A is critically misaligned (ratio difference is 0.048) and B is significantly misaligned (ratio difference is 0.040), and (c) with respect to STS Connection subcategory, sections A, D, E, and F are critically misaligned (ratio difference ranges from 0.022 to 0.033).

Except Section F, instruction that is limited to Remember subcategory is cause of misalignment between written curriculum and the curriculum taught by Teachers (Group W3) at coarse grain level. This resulted in partially or completely ignoring SLO relating to other subcategories of cognitive demand. Therefore, less emphasis on Remember subcategory and more emphasis on Understand and STS Connection subcategories are required for good alignment between the taught and written curricula.

Table 4.16

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group W4)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.018	0.010	0.022	0.006	0.055
B	0.013	0.001	0.014	0.000	0.029
C	0.016	0.001	0.009	0.008	0.035
D	0.019	0.007	0.001	0.012	0.039
E	0.043	0.015	0.011	0.018	0.087
F	0.007	0.011	0.005	0.013	0.037
Total	**0.117**	**0.003**	**0.063**	**0.057**	**0.281**
		Alignment Index			**0.86**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.16 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group W4). It shows that the alignment index between written and taught curricula at coarse grain level is 0.86 which reflects a significant level of alignment. Moreover, this alignment is spread across all the sections (sum of ratio difference range from 0.029 to 0.087). However, Remember subcategory of cognitive demand has relatively higher sum of ratio difference than that of other subcategories. The good alignment between written and taught curricula at coarse grain level for the Teachers (Group W4) is because teachers impart instruction about all the categories of cognitive demand.

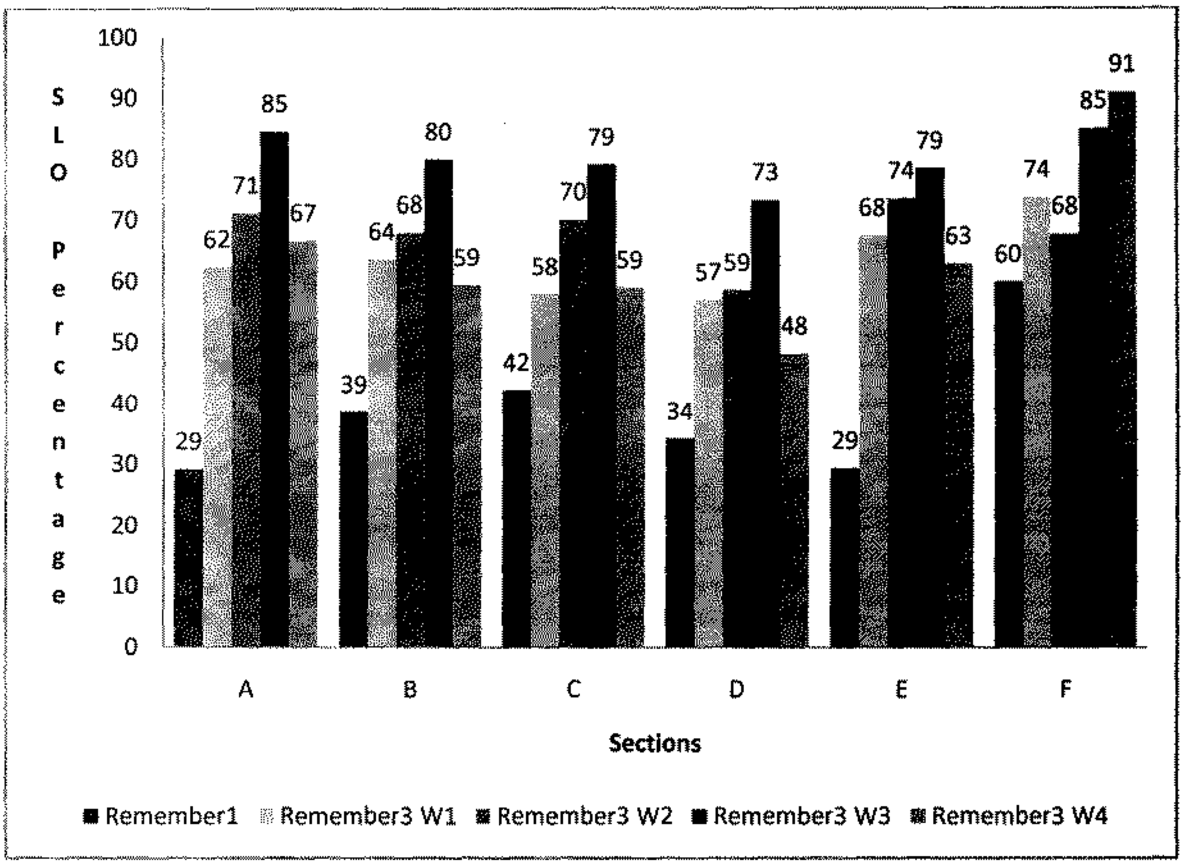

Figure 4.41. Comparison of Written and taught Curricula (Group W1-W4): Coarse Grain Level- Subcategory Remember (*1=Written Curriculum, 3=Taught curriculum, W1=SubgroupW1, W2=SubgroupW2, W3=Subgroup W3, W4=Subgroup W4)*

Figure 4.41 compares written and taught curricula (Group W1-W4) at coarse grain level with respect to cognitive demand's subcategory Remember. It shows that subjects from all the subgroups of Group W give more emphasis to the remember subcategory than that of prescribed by the written curriculum. Moreover, subgroup W3 differs significantly (difference ranges from 25% to 56%) from the written curriculum with respect to SLO percentages of subcategory remember. However, there is relatively less gap (difference ranges from 20% to 34%) in emphasis on subcategory remember between subjects of subgroup W3 and the written curriculum with respect to SLO percentage.

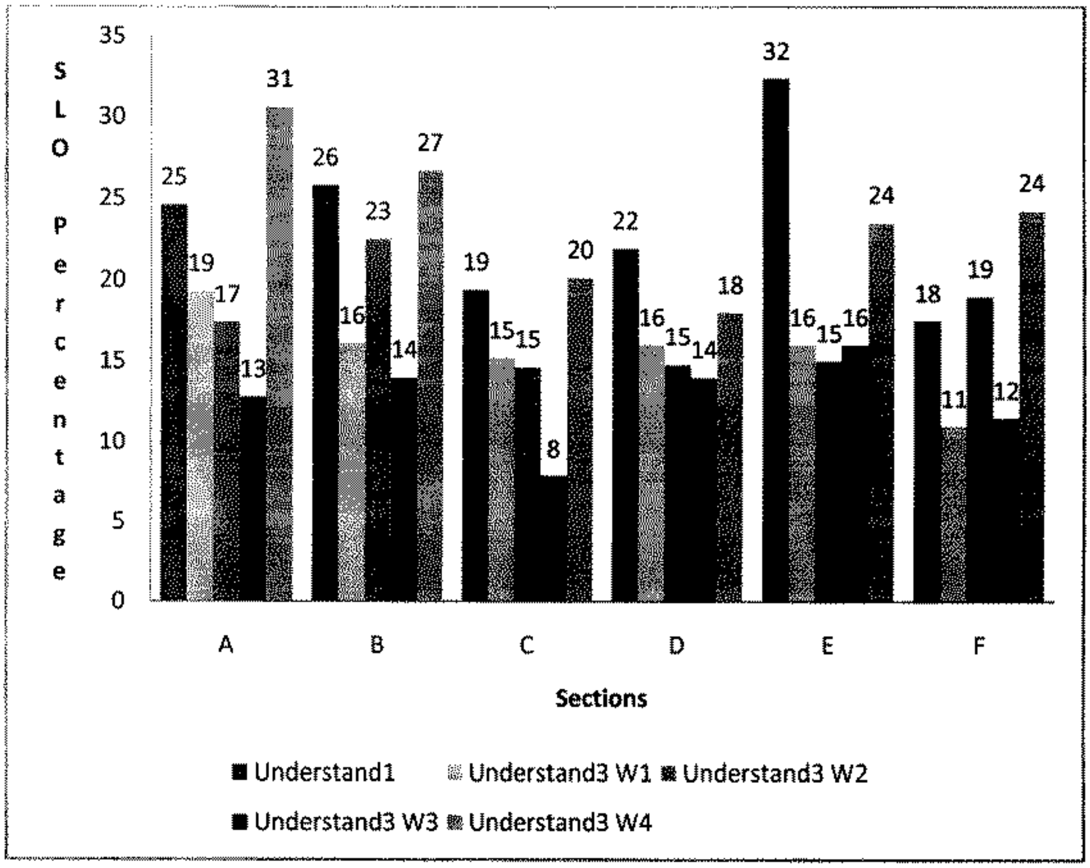

Figure 4.42. Comparison of Written and taught Curricula (Group W1-W4): Coarse Grain Level- Subcategory Understand *(1=Written Curriculum, 3=Taught curriculum, W1=SubgroupW1, W2=SubgroupW2, W3=Subgroup W3, W4=Subgroup W4)*

Figure 4.42 compares written and taught curricula (Group W1-W4) at coarse grain level with respect to cognitive demand's subcategory Understand. It shows that subjects from most of the subgroups of Group W give lesser emphasis to the understand subcategory than that of prescribed in the written curriculum. Moreover, subgroup W3 differs significantly (difference ranges from 6% to 17%) from the written curriculum with respect to SLO percentages of subcategory understand. However, there is relatively less gap (difference ranges from 1% to 8%) in emphasis on subcategory understand between subjects of subgroup W4 and the written curriculum with respect to SLO percentage.

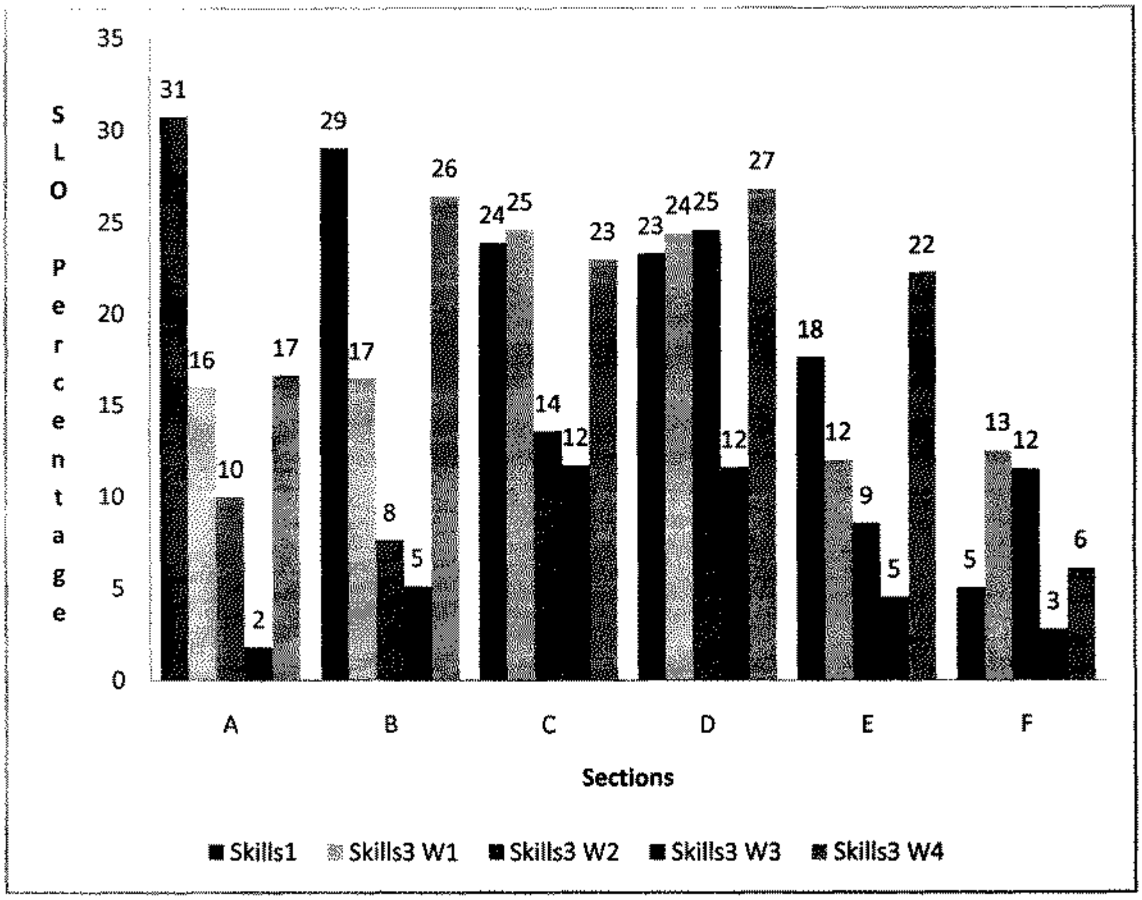

Figure 4.43. Comparison of Written and taught Curricula (Group W1-W4): Coarse Grain Level- Subcategory Skills *(1=Written Curriculum, 3=Taught curriculum, W1=SubgroupW1, W2=SubgroupW2, W3=Subgroup W3, W4=Subgroup W4)*

Figure 4.43 compares written and taught curricula (Group W1-W4) at coarse grain level with respect to cognitive demand's subcategory Skills. It shows that, except in sections C and D, significant gap exists in SLO percentage of the written curriculum and those of subjects from all the subgroups of Group W. Mostly, the subjects give lesser (difference of percentage ranges from 2% to 29%) emphasis to the skills subcategory than that of prescribed in the written curriculum. However, there is relatively less gap (with the difference values 1%, 3%, 4% and 14%) in emphasis on subcategory skills between subjects of subgroup W4 and the written curriculum with respect to SLO percentage.

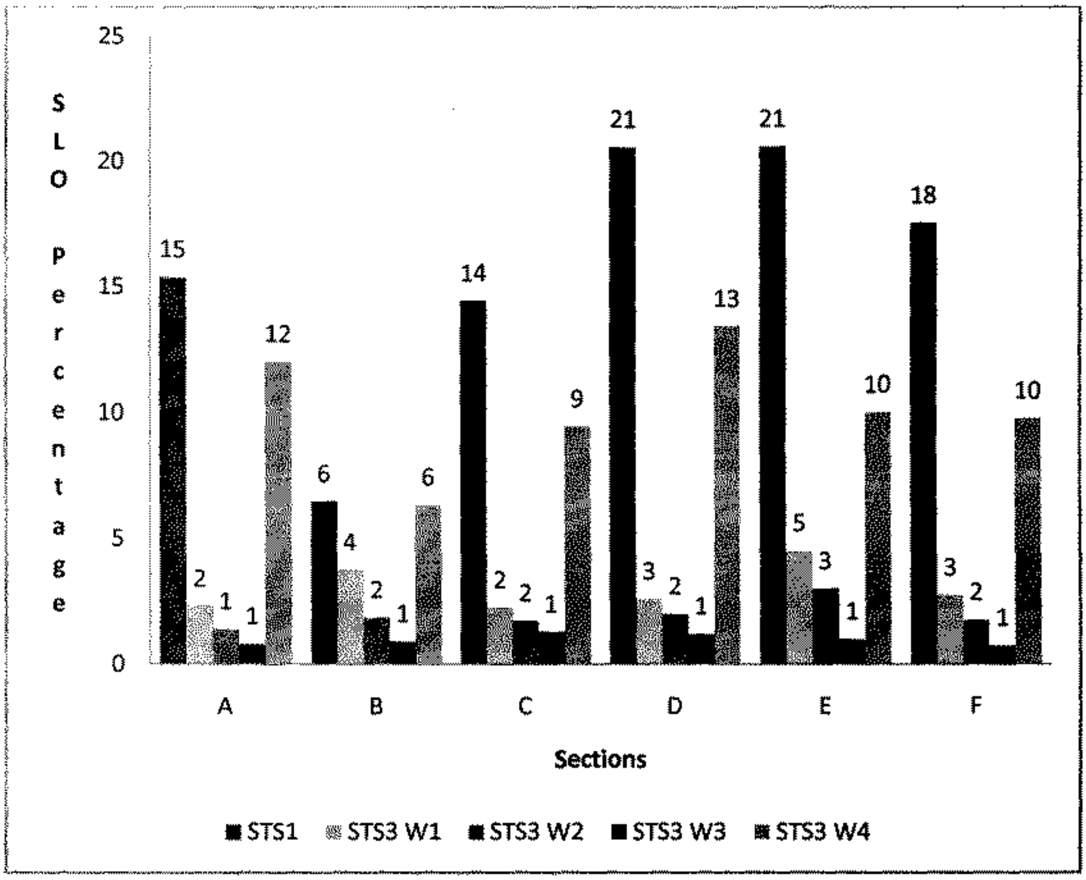

Figure 4.44. Comparison of Written and taught Curricula (Group W1-W4): Coarse Grain Level- Subcategory Understand *(1=Written Curriculum, 3=Taught curriculum, W1=SubgroupW1, W2=SubgroupW2, W3=Subgroup W3, W4=Subgroup W4)*

Figure 4.44 compares written and taught curricula (Group W1-W4) at coarse grain level with respect to cognitive demand's subcategory STS Connection. It shows that, excepts the subjects from subgroup W4, subjects from all other subgroups of Group W give significantly lesser emphasis (difference ranges from 1% to 20%) to the STS Connection subcategory than that of prescribed in the written curriculum. However, there is relatively less gap (difference ranges from 0% to 8%) in emphasis on subcategory STS Connection between subjects of subgroup W4 and the written curriculum with respect to SLO percentage.

Table 4.17

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group X1)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.055	0.014	0.020	0.020	**0.109**
B	0.046	0.024	0.015	0.007	0.092
C	0.041	0.012	0.011	0.019	0.083
D	0.049	0.017	0.003	0.029	0.098
E	0.056	0.028	0.002	0.026	**0.112**
F	0.033	0.012	0.003	0.024	0.071
Total	**0.280**	**0.106**	**0.053**	**0.125**	**0.565**
		Alignment Index			**0.71**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.17 shows alignment level of written curriculum and the curriculum taught by the Teachers (Group X1) at coarse grain level. It shows that the alignment index between written curriculum and the curriculum taught by the Teachers (Group X1) at coarse grain level is 0.71 which reflects a considerable level of alignment. However, the sections A and F (sums of ratio difference are 0.109 and 0.112 respectively) and subcategory STS connection (sum of ratio difference is 0.125) are considerably misaligned.

The causes of misalignment are significant ratio differences: (a) with respect to Remember subcategory in the sections A and E (sum of ratio difference ranges from 0.055 to 0.056), (b) with respect to subcategory Understand, sections B and E (ratio difference are 0.024 and 0.028), and (c) with respect to STS Connection subcategory, sections D and E (ratio difference ranges from 0.026 to 0.029).

Table 4.18

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group X2)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.075	0.015	0.038	0.022	0.150
B	0.060	0.015	0.037	0.008	0.120
C	0.052	0.013	0.018	0.020	0.104
D	0.053	0.017	0.006	0.030	0.106
E	0.077	0.028	0.015	0.033	0.154
F	0.029	0.011	0.006	0.025	0.071
Total	**0.346**	**0.099**	**0.121**	**0.138**	**0.704**
		Alignment Index			**0.65**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.18 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group X2). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group X2) at coarse grain level is 0.65 which reflects a considerable level of misalignment between the two. Moreover, this misalignment is spread across all the sections and subcategories. For example, the subcategories Remember and STS connection (sums of ratio difference are 0.346 and 0.138 respectively) are significantly misaligned. Similarly, sections A and E (sums of ratio difference are 0.150 and 0.154) are significantly misaligned.

The causes of misalignment are critical ratio differences: (a) with respect to Remember subcategory, the sections A, and E are critically misaligned (sum of ratio difference ranges from 0.069 to 0.092), (b) with respect to subcategory Skills, sections A and B (ratio difference are 0.038 and 0.037 respectively), and (c) with respect to STS Connection subcategory, sections D and E (ratio difference ranges from 0.022 to 0.033).

Table 4.19

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group X3)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.094	0.025	0.045	0.023	0.187
B	0.075	0.026	0.040	0.010	0.150
C	0.064	0.020	0.023	0.021	0.128
D	0.077	0.021	0.023	0.032	0.153
E	0.090	0.036	0.023	0.032	0.180
F	0.050	0.016	0.005	0.028	0.099
Total	**0.449**	**0.143**	**0.160**	**0.146**	**0.898**
		Alignment Index			**0.55**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.19 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group X3). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group X3) at coarse grain level is 0.55 which reflect a significant level of misalignment. Moreover, this misalignment is spread across all the sections and subcategories. For example, the subcategories Remember and STS connection (sums of ratio difference are 0.449 and 0.146 respectively) are critically misaligned. Similarly, sections A and E (sums of ratio difference are 0.187 and 0.180) are also critically misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory, the sections A, B, D, and E (sum of ratio difference ranges from 0.075 to 0.094), (b) with respect to subcategory Skills, section A (ratio difference 0.045), and (c) with respect to STS Connection subcategory, sections D, E and F (ratio difference ranges from 0.028 to 0.032).

Table 4.20

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group X4)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.031	0.001	0.021	0.009	0.063
B	0.032	0.010	0.020	0.002	0.064
C	0.034	0.008	0.014	0.012	0.068
D	0.046	0.014	0.012	0.019	0.091
E	0.053	0.023	0.010	0.019	0.105
F	0.026	0.007	0.003	0.016	0.052
Total	**0.222**	**0.063**	**0.081**	**0.078**	**0.443**
		Alignment Index			**0.88**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.20 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group X4). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group X4) at coarse grain level is 0.88 which reflect a good level of alignment. Moreover, this alignment is spread across all the sections (sum of ratio difference range from 0.052 to 0.091). However, section E has relatively higher (0.105) sum of ratio difference and that is due to high (0.053) ratio difference in remember subcategory of cognitive demand. The good alignment between written and taught curricula at coarse grain level for the Teachers (Group X4) is because teachers impart instruction about all the categories of cognitive demand.

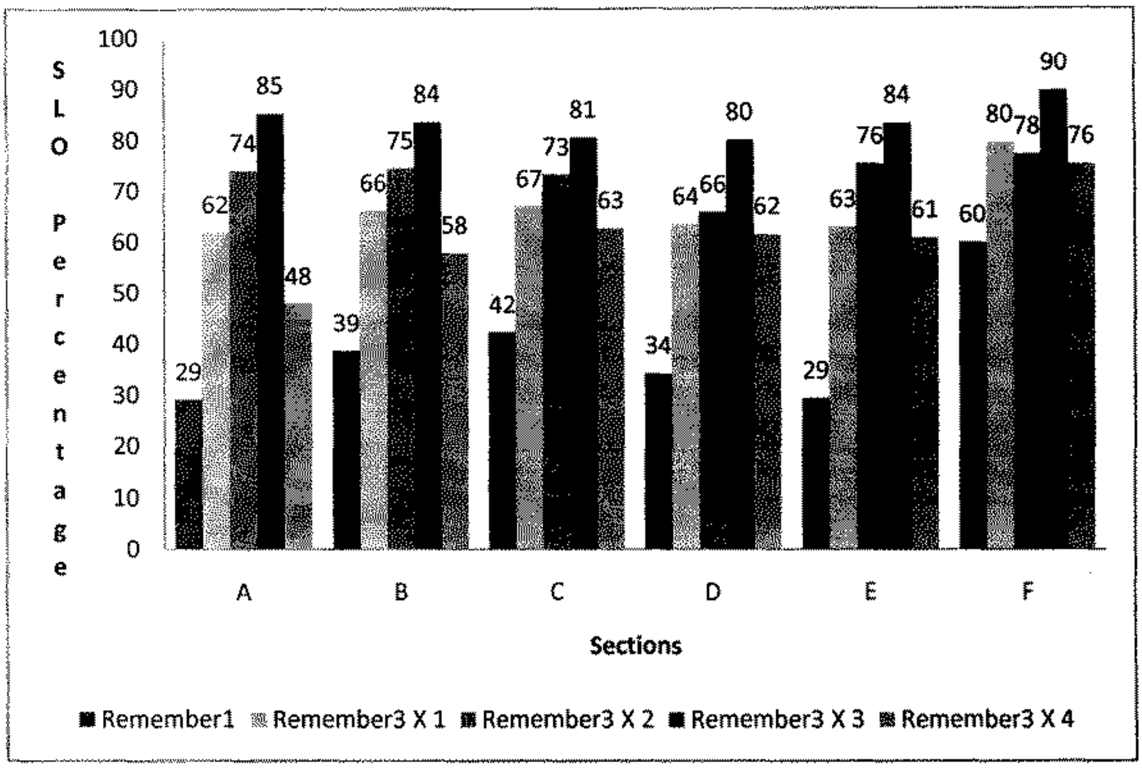

Figure 4.45. Comparison of Written and taught Curricula (Group X1-X4): Coarse Grain Level- Subcategory Remember *(1=Written Curriculum, 3=Taught curriculum, X1=SubgroupX1, X2=SubgroupX2, X3=Subgroup X3, X4=Subgroup X4)*

Figure 4.45 compares written and taught curricula (Group X1-X4) at coarse grain level with respect to cognitive demand's subcategory Remember. It shows that subjects from all the subgroups of Group X give more emphasis to the remember subcategory than that of prescribed by the written curriculum. However, the difference of SLO percentage varies across the section as well as subgroup. For example, the difference of SLO percentage is minimum (ranges from 16% to 30%) in section F and maximum (ranges from 19% to 56%) in section A. Moreover, subgroup X3 differs significantly (difference ranges from 30% to 56%) from the written curriculum with respect to SLO percentages of subcategory remember. However, there is relatively less gap (difference ranges from 11% to 22%) in emphasis on subcategory remember between subjects of subgroup X4 and the written curriculum with respect to SLO percentage.

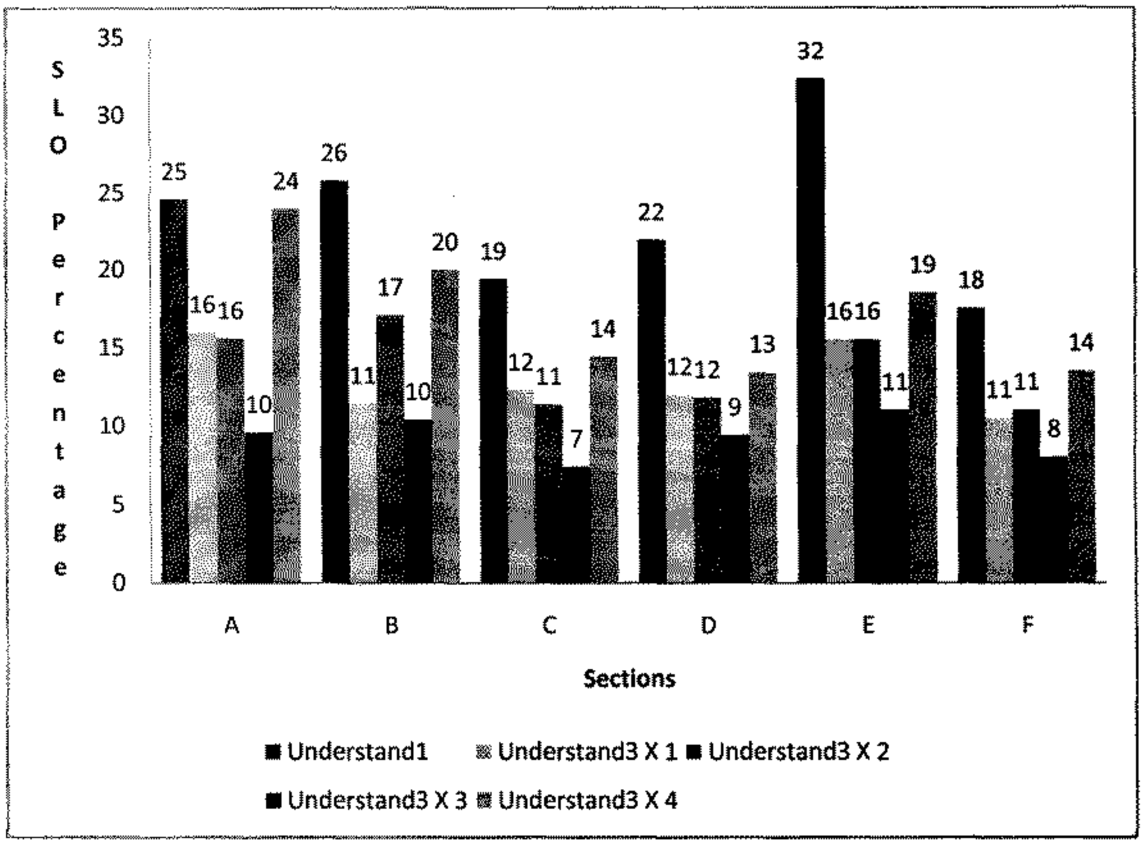

Figure 4.46. Comparison of Written and taught Curricula (Group X1-X4): Coarse Grain Level- Subcategory Understand (*1=Written Curriculum, 3=Taught curriculum, X1=SubgroupX1, X2=SubgroupX2, X3=Subgroup X3, X4=Subgroup X4)*

Figure 4.46 compares written and taught curricula (Group X1-X4) at coarse grain level with respect to cognitive demand's subcategory Understand. It shows that subjects from all subgroups of Group X give less emphasis to the understand subcategory than that of prescribed in the written curriculum. Moreover, subgroup X3 differs significantly (difference ranges from 10% to 21%) from the written curriculum with respect to SLO percentages of subcategory understand. However, there is relatively less gap (difference ranges from 1% to 13%) in emphasis on subcategory understand between subjects of subgroup X4 and the written curriculum with respect to SLO percentage.

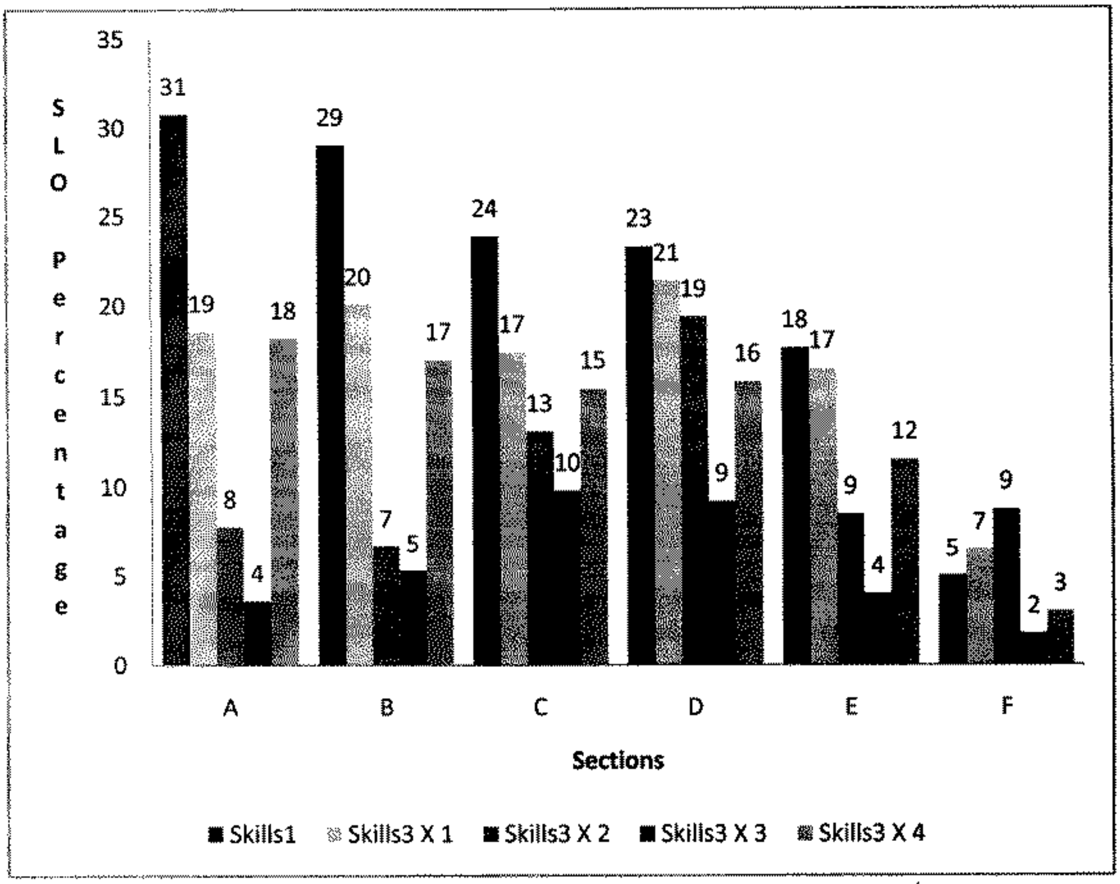

Figure 4.47. Comparison of Written and taught Curricula (Group X1-X4): Coarse Grain Level- Subcategory Skills (*1=Written Curriculum, 3=Taught curriculum, X1=SubgroupX1, X2=SubgroupX2, X3=Subgroup X3, X4=Subgroup X4)*

Figure 4.47 compares written and taught curricula (Group X1-X4) at coarse grain level with respect to cognitive demand's subcategory Skills. It shows that, except in F, a significant gap exists in SLO percentage of the written curriculum and that of subjects from all the subgroups of Group X. Except in section F, all the subjects give lesser (difference of percentage ranges from 2% to 27%) emphasis to the skills subcategory than that of prescribed in the written curriculum. However, there is relatively less gap (with the difference values 1%, to 12%) in emphasis on subcategory skills between subjects of subgroup X2 and the written curriculum with respect to SLO percentage.

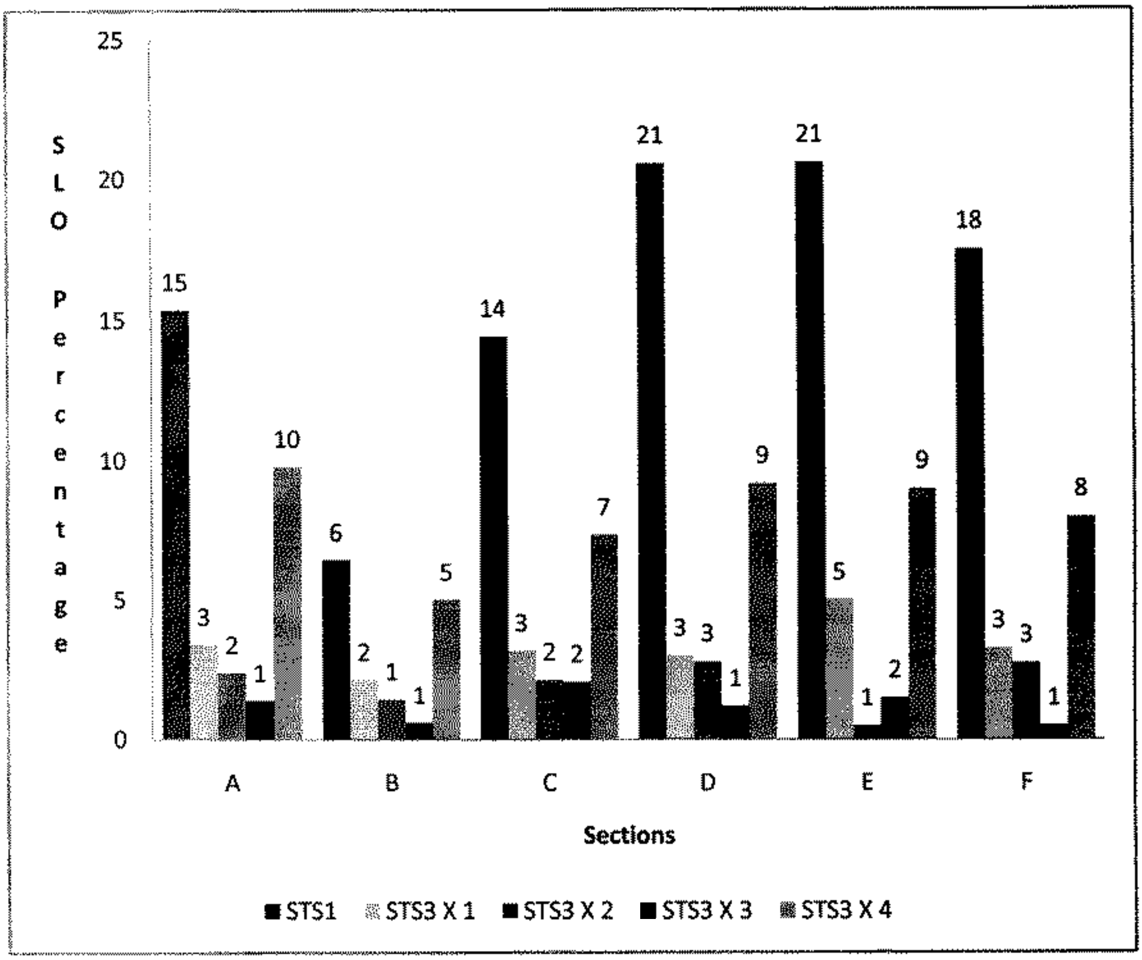

Figure 4.48. Comparison of Written and taught Curricula (Group X1-X4): Coarse Grain Level- Subcategory Understand (*1=Written Curriculum, 3=Taught curriculum, X1=SubgroupX1, X2=SubgroupX2, X3=Subgroup X3, X4=Subgroup X4)*

Figure 4.48 compares written and taught curricula (Group X1-X4) at coarse grain level with respect to cognitive demand's subcategory STS Connection. It shows that subjects from all subgroups of Group X give significantly lesser emphasis (difference ranges from 4% to 20%) to the STS Connection subcategory than that of prescribed in the written curriculum. This less emphasis on subcategory STS Connection is spread all across the Sections as well as subgroups of group. It is maximum (ranges from 12% to 20%) for the sections D and E, and minimum (ranges from 1% to 5%) for section B.

Table 4.21

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Y1)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.075	0.018	0.036	0.021	**0.149**
B	0.059	0.026	0.027	0.006	0.118
C	0.048	0.013	0.016	0.019	0.096
D	0.059	0.015	0.016	0.028	0.118
E	0.068	0.031	0.009	0.028	**0.137**
F	0.032	0.008	0.000	0.024	0.064
Total	0.341	0.111	0.105	0.126	0.683
		Alignment Index			**0.66**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.21 shows alignment level of written curriculum and the curriculum taught by Teachers (Group Y1) at coarse grain level. It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group Y1) at coarse grain level is 0.66 which reflects a considerable level of misalignment. This alignment gap is spread over all the sections as well as subcategories of cognitive demand. For example, the subcategories Remember and STS connection (sums of ratio difference are 0.341 and 0.126 respectively) are significantly misaligned. Similarly, sections A and E (sums of ratio difference are 0.149 and 0.137) are also significantly misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the sections A and E (sum of ratio difference ranges from 0.068 to 0.075), (b) with respect to subcategory STS Connection for sections D, E and F (ratio difference ranges from 0.024 to 0.028).

Table 4.22

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Y2)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.083	0.024	0.039	0.021	**0.167**
B	0.066	0.025	0.036	0.006	**0.133**
C	0.056	0.013	0.022	0.021	0.111
D	0.062	0.017	0.014	0.031	0.125
E	0.073	0.029	0.015	0.029	**0.147**
F	0.013	0.003	0.011	0.026	0.053
Total	**0.354**	**0.109**	**0.137**	**0.135**	**0.734**
		Alignment Index			**0.63**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.22 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Y2). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group Y2) at coarse grain level is 0.63 which reflects a considerable level of misalignment between the two. Moreover, this misalignment is spread across all the sections as well as all the subcategories of cognitive demand. For example, the subcategories Remember and STS connection (sums of ratio difference are 0.354 and 0.135 respectively) are significantly misaligned. Similarly, sections A and E (sums of ratio difference are 0.167 and 0.147) are also significantly misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the sections A, B and E (sum of ratio difference ranges from 0.066 to 0.083), (b) with respect to subcategory STS Connection for sections D, E and F (ratio difference ranges from 0.026 to 0.031).

Table 4.23

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Y3)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.081	0.024	0.043	0.015	**0.163**
B	0.066	0.033	0.034	0.000	**0.132**
C	0.066	0.021	0.024	0.021	**0.132**
D	0.069	0.021	0.019	0.029	**0.137**
E	0.087	0.033	0.023	0.031	**0.174**
F	0.037	0.010	0.001	0.025	0.073
Total	**0.405**	**0.141**	**0.143**	**0.121**	**0.810**
		Alignment Index			**0.59**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.23 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Y3). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group Y3) at coarse grain level is 0.59 which reflects a significant level of misalignment. Moreover, this misalignment is spread across all the sections as well as all the subcategories of cognitive demand. For example, the subcategory Remember (sum of ratio difference is 0.405) is critically misaligned while STS connection (sum of ratio difference is 0.121) is significantly misaligned. Similarly, section E (sum of ratio difference is 0.174) is misaligned to the critical level while sections A and D are also significantly misaligned (sums of ratio difference are 0.163 and 0.137 respectively).

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for all the sections except section F (ratio difference ranges from 0.066 to 0.087), (b) with respect to subcategory STS Connection for sections D, E and F (ratio difference ranges from 0.025 to 0.031).

Table 4.24

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Y4)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.030	0.003	0.018	0.009	0.060
B	0.026	0.010	0.021	0.006	0.063
C	0.029	0.006	0.013	0.010	0.057
D	0.042	0.012	0.013	0.017	0.083
E	0.045	0.016	0.008	0.021	0.090
F	0.006	0.003	0.003	0.007	0.018
Total	**0.178**	**0.051**	**0.075**	**0.068**	**0.372**
		Alignment Index			**0.81**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.24 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Y4). It shows that the alignment index between written curriculum and the curriculum taught by Teachers (Group Y4) at coarse grain level is 0.81 which reflects a good level of alignment. Moreover, this alignment is spread across all the sections (sum of ratio difference range from 0.018 to 0.090). However, section E has relatively higher (0.090) sum of ratio difference and that is due to high (0.045) ratio difference in remember subcategory of cognitive demand. The good alignment between written and taught curricula at coarse grain level for the Teachers (Group Y4) is because teachers impart instruction about all the categories of cognitive demand.

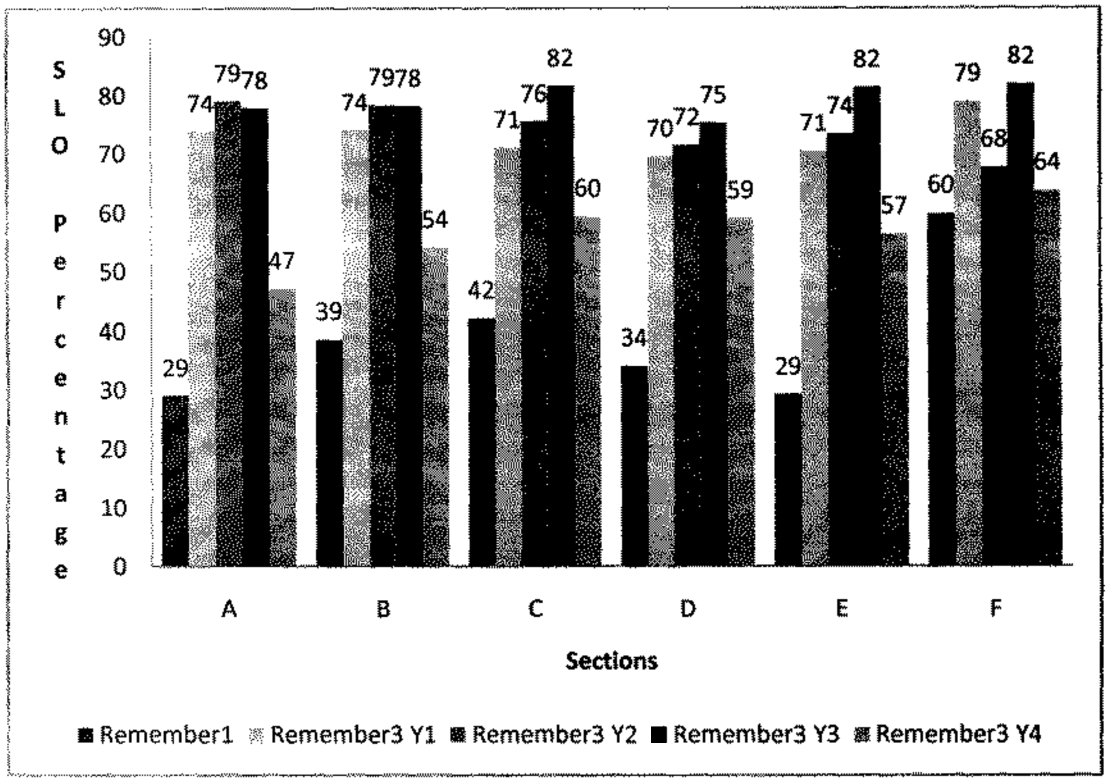

Figure 4.49. Comparison of Written and taught Curricula (Group Y1-Y4): Coarse Grain Level- Subcategory Remember *(1=Written Curriculum, 3=Taught curriculum, Y1=SubgroupY1, Y2=SubgroupY2, Y3=Subgroup Y3, Y4=Subgroup Y4)*

Figure 4.49 compares written and taught curricula (Group Y1-Y4) at coarse grain level with respect to cognitive demand's subcategory Remember. It shows that subjects from all the subgroups of Group Y give more emphasis to the remember subcategory than that of prescribed by the written curriculum. However, the difference of SLO percentage varies across the section as well as subgroup. For example, the difference of SLO percentage is minimum (ranges from 4% to 22%) in section F and maximum (ranges from 18% to 50%) in section A. Moreover, subgroup Y3 differs significantly (difference ranges from 22% to 49%) from the written curriculum with respect to SLO percentages of subcategory remember. However, there is relatively less gap (difference ranges from 4% to 18%) in emphasis on subcategory remember between subjects of subgroup Y4 and the written curriculum with respect to SLO percentage.

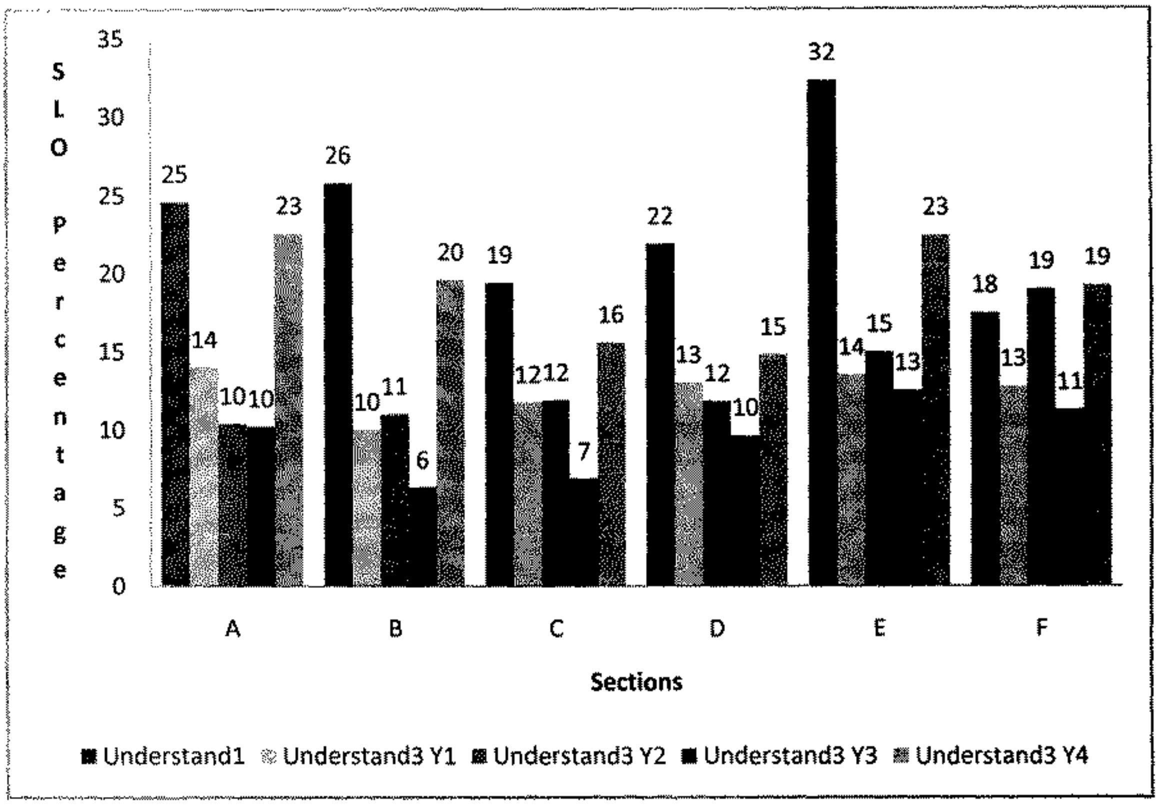

Figure 4.50. Comparison of Written and taught Curricula (Group Y1-Y4): Coarse Grain Level- Subcategory Understand (*1=Written Curriculum, 3=Taught curriculum, Y1=SubgroupY1, Y2=SubgroupY2, Y3=Subgroup Y3, Y4=Subgroup Y4)*

Figure 4.50 compares written and taught curricula (Group Y1-Y4) at coarse grain level with respect to cognitive demand's subcategory Understand. It shows that, except for section F, subjects from all subgroups of Group Y give lesser emphasis to the understand subcategory than that of prescribed in the written curriculum. However, the difference of SLO percentage varies across the section as well as subgroup. For example, the difference of SLO percentage is minimum (ranges from 1% to 7%) in section F and maximum (ranges from 6% to 20%) in section B. Moreover, subgroup Y3 differs significantly (difference ranges from 7% to 20%) from the written curriculum with respect to SLO percentages of subcategory understand. However, there is relatively less gap (difference ranges from 1% to 9%) in emphasis on subcategory understand between subjects of subgroup Y4 and the written curriculum with respect to SLO percentage.

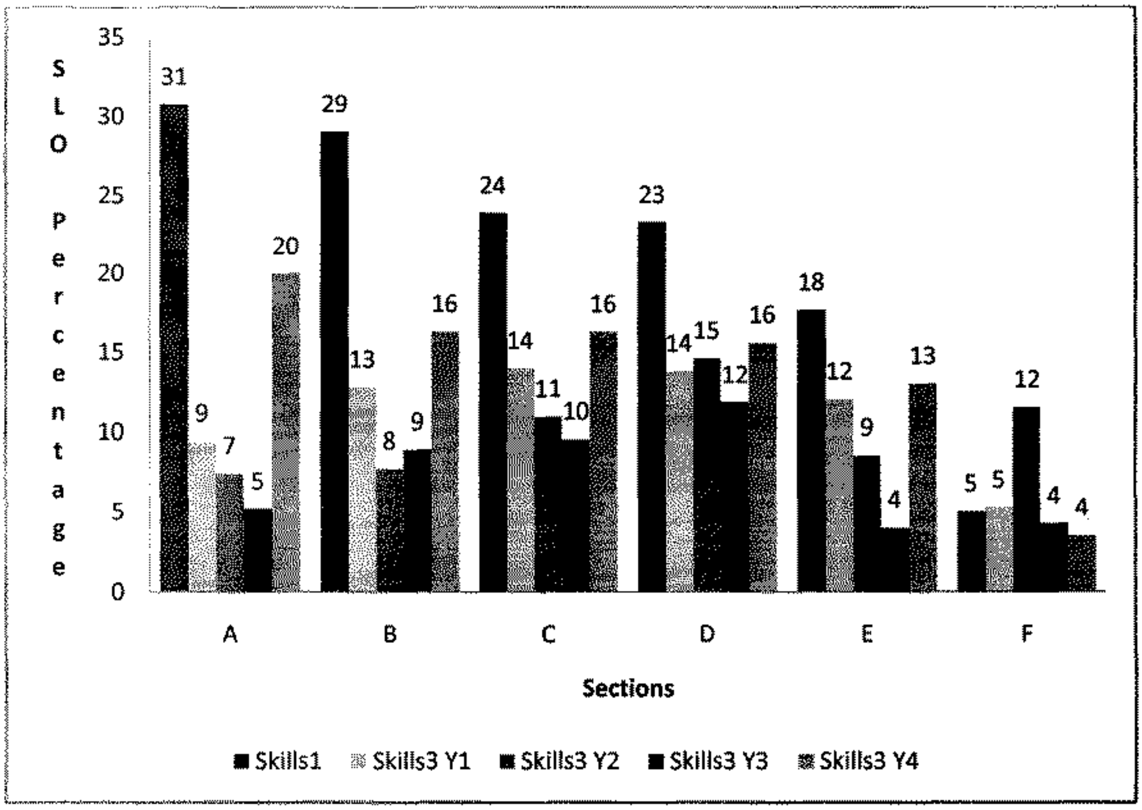

Figure 4.51. Comparison of Written and taught Curricula (Group Y1-Y4): Coarse Grain Level- Subcategory Skills (*1=Written Curriculum, 3=Taught curriculum, Y1=SubgroupY1, Y2=SubgroupY2, Y3=Subgroup Y3, Y4=Subgroup Y4)*

Figure 4.51 compares written and taught curricula (Group Y1-Y4) at coarse grain level with respect to cognitive demand's subcategory Skills. It shows that, except in F, a significant gap exists in SLO percentage of the written curriculum and that of subjects from all the subgroups of Group Y. Except in section F, all the subjects give lesser (difference of percentage ranges from 5% to 26%) emphasis to the skills subcategory than that of prescribed in the written curriculum. However, there is relatively less gap (with the difference values 1%, to 13%) in emphasis on subcategory skills between subjects of subgroup Y4 and the written curriculum with respect to SLO percentage. This difference of SLO percentage also varies across the sections. It is minimum (ranges from 0% to 7%) in section F and maximum (ranges from 11% to 26%) in section A.

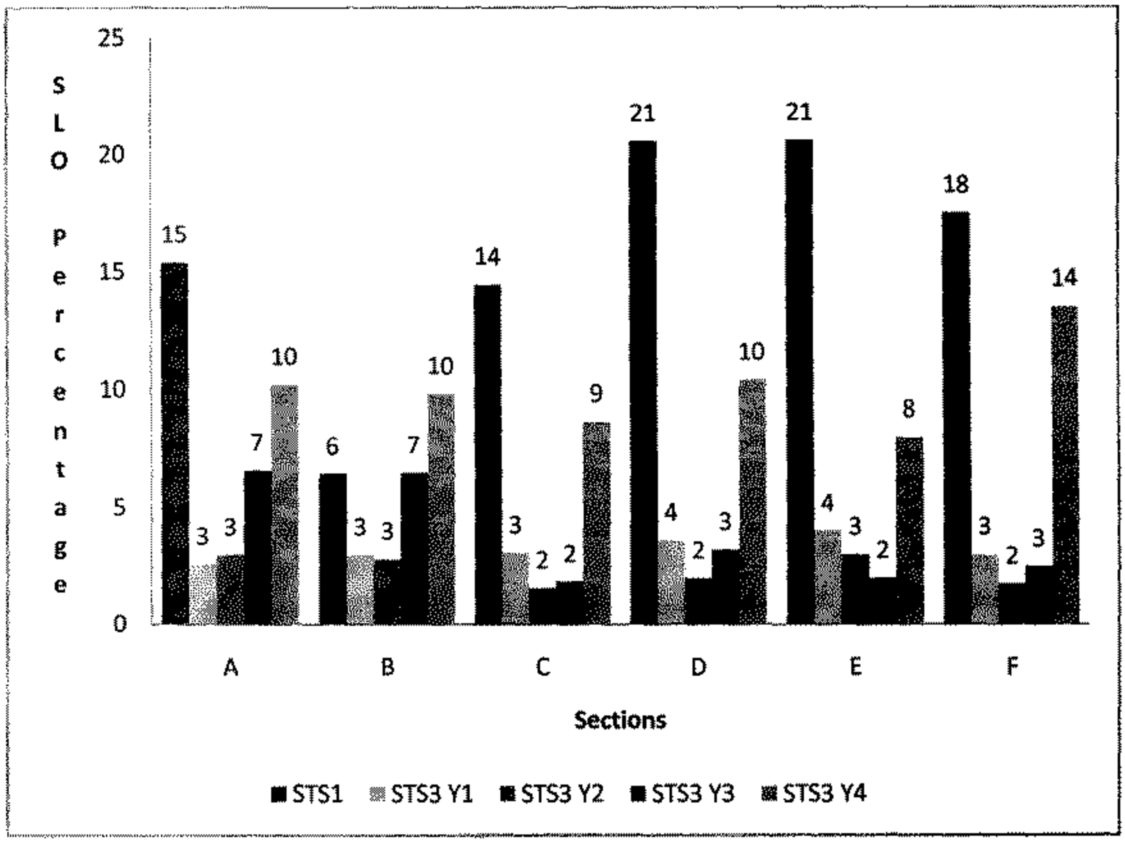

Figure 4.52. Comparison of Written and taught Curricula (Group Y1-Y4): Coarse Grain Level- Subcategory Understand *(1=Written Curriculum, 3=Taught curriculum, Y1=SubgroupY1, Y2=SubgroupY2, Y3=Subgroup Y3, Y4=Subgroup Y4)*

Figure 4.52 compares written and taught curricula (Group Y1-Y4) at coarse grain level with respect to cognitive demand's subcategory STS Connection. It shows that subjects from all subgroups of Group Y give significantly lesser emphasis (difference ranges from 1% to 19%) to the STS Connection subcategory than that of prescribed in the written curriculum. This less emphasis on subcategory STS Connection is spread all across the Sections as well as subgroups of group. It is maximum (ranges from 13% to 19%) for the section E, and minimum (ranges from 3% to 7%) for section B.

Table 4.25

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Z1)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.056	0.022	0.024	0.010	0.111
B	0.042	0.025	0.019	0.002	0.088
C	0.040	0.013	0.014	0.013	0.080
D	0.053	0.017	0.014	0.022	0.107
E	0.065	0.034	0.006	0.025	**0.130**
F	0.003	0.012	0.018	0.008	0.041
Total	**0.259**	**0.124**	**0.059**	**0.076**	**0.556**
	Alignment Index				**0.72**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.25 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Z1). It shows that the alignment index between written and taught curricula at grain level is 0.72 which reflects a considerable level of alignment. However, this alignment is not spread over all sections and subcategories of cognitive domain. For example, section E (sum of ratio difference is 0.259) is significantly misaligned. Similarly, sections A and D (sums of ratio difference are 0.111 and 0.107 respectively) and the subcategory Remember (sum of ratio difference is 0.259) are considerably misaligned.

The causes of misalignment are significant ratio differences: (a) with respect to Remember subcategory for the sections A, D and E (ratio difference ranges from 0.053 to 0.065), and (b) with respect to subcategory STS Connection for section E (ratio difference is 0.025).

Table 4.26

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Z2)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.068	0.023	0.036	0.009	**0.136**
B	0.049	0.026	0.032	0.009	0.116
C	0.052	0.015	0.019	0.018	0.103
D	0.075	0.023	0.022	0.029	**0.149**
E	0.078	0.037	0.013	0.028	**0.155**
F	0.004	0.001	0.018	0.020	0.043
Total	**0.324**	**0.126**	**0.104**	**0.095**	**0.702**
		Alignment Index			**0.65**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.26 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Z2). It shows that the alignment index between written and taught curricula at coarse grain level is 0.65 which reflects a considerable level of misalignment between the two. Moreover, this misalignment is spread over various sections and subcategories of cognitive domain. For example, sections A, D, and E (sum of ratio difference ranges from 0.136 to 0.155) and the subcategory Remember (sum of ratio difference is 0.324) are significantly misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the sections A, D and E (ratio difference ranges from 0.068 to 0.078) (b) with respect to subcategory STS Connection for sections D and E (ratio difference ranges from 0.28 to 0.029).

Table 4.27

Alignment level of Written and Taught Curricula: Coarse Grain Level (Group Z3)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.075	0.026	0.036	0.013	**0.149**
B	0.062	0.030	0.036	0.004	0.132
C	0.059	0.021	0.024	0.015	0.119
D	0.072	0.026	0.024	0.022	**0.143**
E	0.087	0.045	0.015	0.027	**0.174**
F	0.027	0.018	0.010	0.018	0.073
Total	**0.382**	**0.166**	**0.125**	**0.090**	**0.790**
		Alignment Index			**0.61**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.27 shows alignment level of written and taught curricula at coarse grain level for the Teachers (Group Z3). It shows that the alignment index between written and taught curricula at coarse grain level is 0.61 which reflect a considerable level of misalignment. Moreover, this alignment is spread over various sections and subcategories of cognitive domain. For example, sections A and D (sum of ratio difference ranges from 0.132 to 0.143) and the subcategory Remember (sum of ratio difference is 0.382) are significantly misaligned. Similarly, section E (sum of ratio difference is 0.174) is misaligned to the critical level.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the sections A, D and E (sum of ratio difference ranges from 0.072 to 0.087), and (b) section E with respect to subcategories Understand (ratio difference is 0.045) and STS Connection (ratio difference is 0.027).

Table 4.28

Alignment level of Written and Taught Curricula: Coarse Grain level (Group Z4)

Section Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Subtotal**
A	0.040	0.002	0.026	0.013	0.081
B	0.033	0.012	0.022	0.000	0.067
C	0.028	0.006	0.014	0.008	0.056
D	0.033	0.011	0.008	0.013	0.065
E	0.049	0.025	0.010	0.014	0.099
F	0.012	0.005	0.004	0.014	0.035
Total	**0.195**	**0.050**	**0.084**	**0.061**	**0.403**
		Alignment Index			**0.80**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.28 shows alignment level of written and taught curricula at Grain level for the Teachers (Group Z4). It shows that the alignment index between written and taught curricula at grain level is 0.80 which reflects a significant level of alignment. Moreover, this alignment is spread across all the sections (sum of ratio difference range from 0.035 to 0.099). However, section E has relatively higher (0.099) sum of ratio difference and that is due to high (0.049) ratio difference in remember subcategory of cognitive demand.

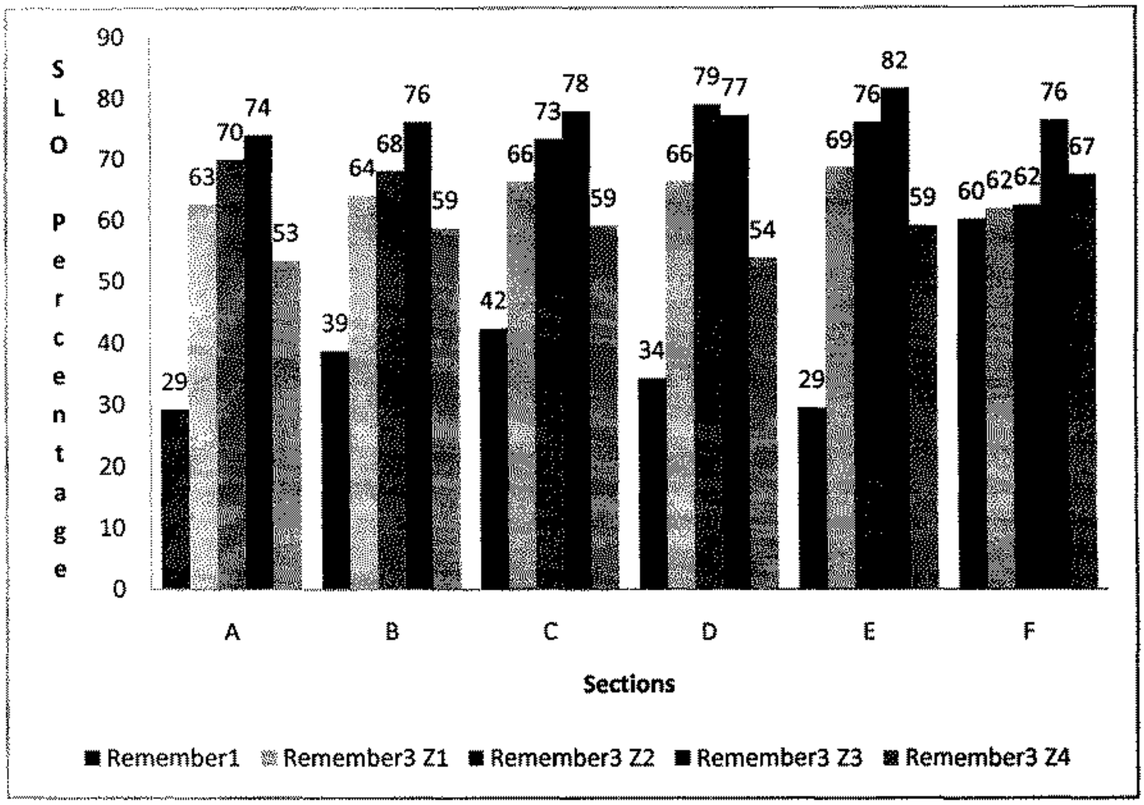

Figure 4.53. Comparison of Written and taught Curricula (Group Z1-Z4): Coarse Grain Level- Subcategory Remember (*1=Written Curriculum, 3=Taught curriculum, Z1=SubgroupZ1, Z2=SubgroupZ2, Z3=Subgroup Z3, Z4=Subgroup Z4)*

Figure 4.53 compares written and taught curricula (Group Z1-Z4) at coarse grain level with respect to cognitive demand's subcategory Remember. It shows that subjects from all the subgroups of Group Z give more emphasis to the remember subcategory than that of prescribed by the written curriculum. However, the difference of SLO percentage varies across the section as well as subgroup. For example, the difference of SLO percentage is minimum (ranges from 2% to 17%) in section F and maximum (ranges from 30% to 53%) in section E. Moreover, subgroup Z3 differs significantly (difference ranges from 16% to 53%) from the written curriculum with respect to SLO percentages of subcategory remember. However, there is relatively less gap (difference ranges from 7% to 30%) in emphasis on subcategory remember between subjects of subgroup Z4 and the written curriculum with respect to SLO percentage.

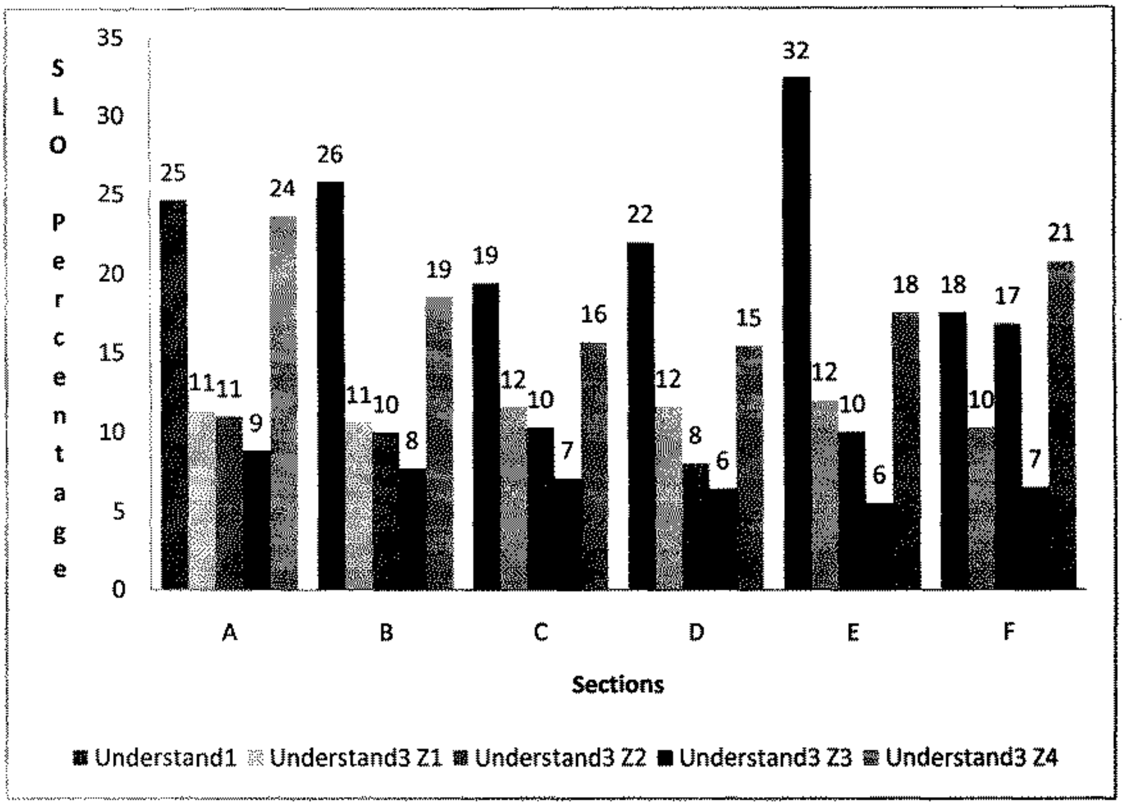

Figure 4.54. Comparison of Written and taught Curricula (Group Z1-Z4): Coarse Grain Level- Subcategory Understand (*1=Written Curriculum, 3=Taught curriculum, Z1=SubgroupZ1, Z2=SubgroupZ2, Z3=Subgroup Z3, Z4=Subgroup Z4)*

Figure 4.54 compares written and taught curricula (Group Z1-Z4) at coarse grain level with respect to cognitive demand's subcategory Understand. It shows that, except for section F, subjects from all subgroups of Group Z give lesser emphasis to the understand subcategory than that of prescribed in the written curriculum. However, the difference of SLO percentage varies across the section as well as subgroup. For example, the difference of SLO percentage is minimum (ranges from 1% to 11%) in section F and maximum (ranges from 14% to 26%) in section B. Moreover, subgroup Z3 differs significantly (difference ranges from 11% to 26%) from the written curriculum with respect to SLO percentages of subcategory understand. However, there is relatively less gap (difference ranges from 1% to 14%) in emphasis on subcategory understand between subjects of subgroup Z4 and the written curriculum with respect to SLO percentage.

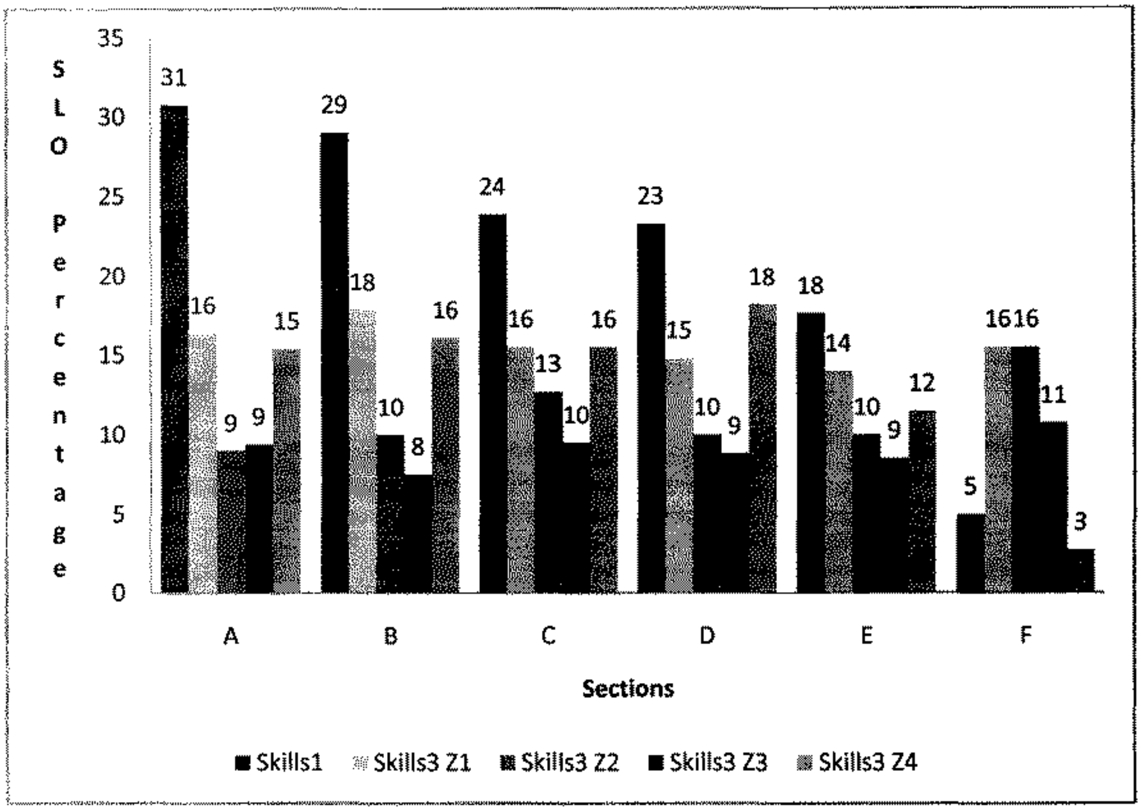

Figure 4.55. Comparison of Written and taught Curricula (Group Z1-Z4): Coarse Grain Level- Subcategory Skills (*1=Written Curriculum, 3=Taught curriculum, Z1=SubgroupZ1, Z2=SubgroupZ2, Z3=Subgroup Z3, Z4=Subgroup Z4)*

Figure 4.55 compares written and taught curricula (Group Z1-Z4) at coarse grain level with respect to cognitive demand's subcategory Skills. It shows that, except in F, a significant gap exists in SLO percentage of the written curriculum and that of subjects from all the subgroups of Group Z. Except in section F, all the subjects give lesser (difference of percentage ranges from 2% to 22%) emphasis to the skills subcategory than that of prescribed in the written curriculum. However, there is relatively less gap (with the difference values 2%, to 16%) in emphasis on subcategory skills between subjects of subgroup Z4 and the written curriculum with respect to SLO percentage. This difference of SLO percentage also varies across the sections. It is minimum (ranges from 4% to 9%) in section E and maximum (ranges from 16% to 22%) in section A.

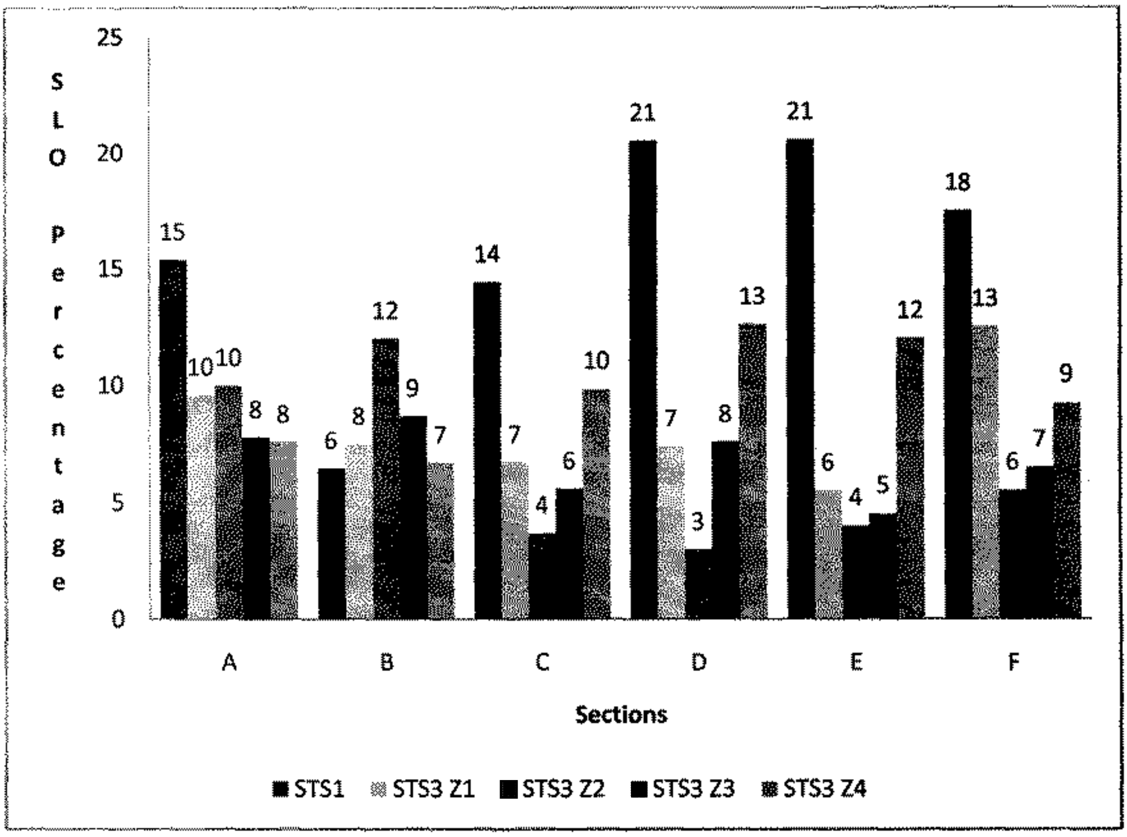

Figure 4.56. Comparison of Written and taught Curricula (Group Z1-Z4): Coarse Grain Level- Subcategory Understand *(1=Written Curriculum, 3=Taught curriculum, Z1=SubgroupZ1, Z2=SubgroupZ2, Z3=Subgroup Z3, Z4=Subgroup Z4)*

Figure 4.56 compares written and taught curricula (Group Z1-Z4) at coarse grain level with respect to cognitive demand's subcategory STS Connection. It shows that, except for section B, subjects from all subgroups of Group Z give significantly lesser emphasis (difference ranges from 4% to 18%) to the STS Connection subcategory than that of prescribed in the written curriculum. This less emphasis on subcategory STS Connection is spread all across the Sections as well as subgroups. It is maximum (ranges from 8% to 18%) for the section D, and minimum (ranges from 1% to 6%) for section B. Across the subgroups, it is minimum (with the difference values 1%, to 9%) for subgroup Z4 and maximum for subgroup Z3 (with the difference values 6%, to 18%).

Table 4.29

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group W1)

Topic Number	**Ratio Difference with respect to**				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.021	0.012	0.000	0.010	0.043
1b	0.011	0.007	0.005	0.001	0.024
2a	0.029	0.003	0.029	0.003	**0.063**
3a	0.012	0.003	0.003	0.013	0.031
3b	0.016	0.005	0.010	0.011	0.041
4a	0.026	0.007	0.005	0.015	**0.052**
4b	0.035	0.019	0.017	0.001	**0.072**
4c	0.006	0.015	0.017	0.004	0.042
4d	0.015	0.000	0.001	0.014	0.030
5a	0.004	0.002	0.007	0.001	0.014
5b	0.003	0.009	0.009	0.003	0.025
6a	0.011	0.007	0.005	0.001	0.024
6b	0.026	0.018	0.009	0.001	**0.054**
7a	0.003	0.000	0.009	0.012	0.024
7b	0.016	0.012	0.005	0.001	0.034
8a	0.008	0.010	0.007	0.005	0.030
8b	0.010	0.001	0.012	0.003	0.026
9a	0.019	0.006	0.014	0.001	0.040
9b	0.003	0.010	0.003	0.004	0.020
Total	**0.272**	**0.144**	**0.168**	**0.102**	**0.686**
	Alignment Index				**0.66**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.29 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W1 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group W1 to Grade IX students at fine grain level is 0.66 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 4b, and 6b (sum of ratio difference ranges from 0.054 to 0.072) and subcategory STS connection (sum of ratio difference is 0.102) are misaligned to the critical level. Similarly, topics 1a, and 4a (sums of ratio difference are 0.043 and 0.052) are significantly misaligned while subcategories Remember and Skills (sums of ratio difference are 0.272and 0.168 respectively) considerably misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the topics 2a, 4a, 4b, and 6b (ratio difference ranges from 0.021 to 0.035), (b) with respect to Understand subcategory for the topics 4b,4c, and 6b (ratio difference ranges from 0.015 to 0.019), (c) with respect to skills subcategory for the topics 2a, 4b and 4c (ratio difference ranges from 0.017 to 0.029), and (d) with respect to STS Connection subcategory for the topics 1a, 4a, 4d, and 7a (ratio difference ranges from 0.010 to 0.015).

Table 4.30

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group W2)

Topic	Ratio Difference with respect to				
Number	**Remember13**	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.024	0.012	0.000	0.012	0.048
1b	0.004	0.006	0.001	0.001	0.012
2a	0.029	0.001	0.031	0.003	**0.062**
3a	0.028	0.005	0.011	0.013	**0.056**
3b	0.027	0.001	0.016	0.011	**0.054**
4a	0.013	0.008	0.005	0.015	0.041
4b	0.026	0.003	0.023	0.001	**0.054**
4c	0.019	0.004	0.019	0.004	0.045
4d	0.030	0.001	0.014	0.014	**0.060**
5a	0.011	0.002	0.012	0.000	0.025
5b	0.015	0.007	0.005	0.003	0.030
6a	0.006	0.003	0.009	0.000	0.018
6b	0.027	0.013	0.015	0.001	**0.056**
7a	0.001	0.000	0.004	0.003	0.008
7b	0.016	0.012	0.006	0.002	0.036
8a	0.016	0.012	0.001	0.005	0.035
8b	0.005	0.005	0.002	0.003	0.015
9a	0.027	0.012	0.016	0.001	**0.055**
9b	0.003	0.006	0.003	0.006	0.018
Total	**0.324**	**0.111**	**0.193**	**0.098**	**0.726**
		Alignment Index			**0.64**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.30 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W2 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group W2 to Grade

IX students at fine grain level is 0.64 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 1a, 2a, 3a, 3b, 4b, 4d, 6b and 9a (sum of ratio difference ranges from 0.048 to 0.062) and subcategory STS connection (sum of ratio difference is 0.098) are misaligned to the critical level. Similarly, topic 4c (sum of ratio difference is 0.045) and subcategory Remember (sum of ratio difference is 0.324) are significantly misaligned.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the topics 1a, 2a, 3a, 3b, 4b, 4d, 6b, and 9a (ratio difference ranges from 0.024 to 0.030), (b) with respect to Understand subcategory for the topics 1a,6b, 7b, 8a, and 9a (ratio difference ranges from 0.012 to 0.013), (c) with respect to skills subcategory for the topics 2a, 3b, 4b, 4c, and 6b (ratio difference ranges from 0.017 to 0.029), and (d) with respect to STS Connection subcategory for the topics 1a, 2a, 3a, 3b, 4b, 4d, 6b, and 9a (ratio difference ranges from 0.011 to 0.015).

Table 4.31

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group W3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.022	0.012	0.000	0.010	0.044
1b	0.023	0.006	0.017	0.000	0.046
2a	0.042	0.007	0.035	0.000	**0.085**
3a	0.027	0.004	0.011	0.013	**0.055**
3b	0.032	0.006	0.016	0.011	**0.064**
4a	0.029	0.007	0.006	0.016	**0.058**
4b	0.038	0.017	0.021	0.000	**0.077**
4c	0.017	0.002	0.017	0.003	0.038
4d	0.034	0.005	0.014	0.014	**0.067**
5a	0.015	0.001	0.014	0.000	0.031
5b	0.026	0.015	0.008	0.004	**0.052**
6a	0.006	0.002	0.009	0.000	0.017
6b	0.028	0.013	0.015	0.001	**0.057**
7a	0.011	0.001	0.013	0.002	0.027
7b	0.021	0.012	0.009	0.001	0.043
8a	0.022	0.012	0.004	0.006	0.044
8b	0.005	0.001	0.001	0.003	0.011
9a	0.024	0.011	0.014	0.001	**0.050**
9b	0.010	0.000	0.004	0.006	0.020
Total	**0.433**	**0.136**	**0.227**	**0.087**	**0.883**
		Alignment Index			**0.56**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.31 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W3 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group W3 to Grade IX students at fine grain level is 0.56 which reflects a significant misalignment level.

However, degree of misalignment is different for different topics and subcategories. The topics 2a, 3a, 3b, 4a, 4b, 4d, and 6b (sum of ratio difference ranges from 0.055 to 0.085) and subcategory Remember (sum of ratio difference is 0.433) are misaligned to the critical level. Similarly, topics 1a, 1b, 5b, 6b, 7b, 8a, and 9a (sum of ratio difference ranges from 0.043 to 0.052) and subcategories Skills and STS connection (sums of ratio difference are 0.227 and 0.087 respectively) are significantly misaligned.

Most of the topics (2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, and 9a) are comparatively more misaligned (sum of ratio difference ranges from 0.050 to 0.085). On the other hand, there are some topics (6a, 8b, and 9b) that are comparatively less misaligned (sum of ratio difference ranges from 0.011to 0.020). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Skills are comparatively more misaligned (sum of ratio differences are 0.433 and 0.227) than the other subcategories.

The causes of misalignment are critical level ratio differences: (a) with respect to Remember subcategory for the topics 1a, 1b, 2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, 8a, and 9a (ratio difference ranges from 0.022 to 0.042), (b) with respect to Understand subcategory for the topics 4b and 5b (ratio difference ranges from 0.015 to 0.017), (c) with respect to skills subcategory for the topics 1b, 2a, 3b, 4a, and 6b (ratio difference ranges from 0.015 to 0.035), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, and 4d (ratio difference ranges from 0.010 to 0.016).

Table 4.32

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group W4)

Topic	Ratio Difference with respect to				
Number	**Remember13**	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.005	0.006	0.000	0.001	0.012
1b	0.006	0.003	0.009	0.000	0.017
2a	0.009	0.007	0.016	0.000	0.032
3a	0.006	0.007	0.006	0.007	0.025
3b	0.003	0.001	0.006	0.003	0.012
4a	0.002	0.006	0.006	0.013	0.026
4b	0.016	0.007	0.009	0.000	0.031
4c	0.001	0.002	0.005	0.002	0.010
4d	0.002	0.008	0.003	0.008	0.022
5a	0.007	0.001	0.006	0.000	0.015
5b	0.004	0.001	0.003	0.003	0.011
6a	0.006	0.002	0.004	0.000	0.012
6b	0.009	0.006	0.009	0.007	0.032
7a	0.003	0.003	0.007	0.006	0.019
7b	0.005	0.002	0.005	0.003	0.015
8a	0.004	0.002	0.002	0.003	0.011
8b	0.006	0.006	0.002	0.001	0.015
9a	0.008	0.003	0.010	0.005	0.027
9b	0.003	0.002	0.002	0.003	0.010
Total	**0.106**	**0.076**	**0.110**	**0.064**	**0.355**
		Alignment Index			**0.82**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.32 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W4 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group W4 to Grade IX students at fine grain level is 0.82 which reflects a significant alignment level. The sum of ratio difference between written curriculum and the curriculum taught by Group W4 to Grade IX students ranges from 0.010 to 0.032. Most of the topics (2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, and 9a) are comparatively more misaligned (sum of ratio difference ranges from 0.050 to 0.085). On the other hand, there are some topics (6a, 8b, and 9b) that are comparatively less misaligned (sum of ratio difference ranges from 0.011to 0.020). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Skills are comparatively more misaligned (sum of ratio differences are 0.433 and 0.227) than the other subcategories.

Table 4.33

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group W1)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.019	0.001	0.017	0.003	**0.040**
10b	0.011	0.006	0.007	0.024	**0.048**
11a	0.002	0.010	0.006	0.002	0.020
11b	0.004	0.003	0.001	0.006	0.012
12a	0.013	0.007	0.001	0.005	0.025
12b	0.016	0.005	0.000	0.012	0.033
12c	0.016	0.006	0.008	0.017	**0.047**
13a	0.001	0.003	0.002	0.006	0.012
13b	0.001	0.003	0.001	0.004	0.009
13c	0.020	0.021	0.012	0.010	**0.064**
14a	0.008	0.004	0.004	0.009	0.025
14b	0.004	0.004	0.008	0.000	0.017
14c	0.008	0.004	0.004	0.008	0.024
15a	0.008	0.002	0.008	0.018	0.037
15b	0.021	0.009	0.004	0.008	**0.042**
16a	0.009	0.006	0.002	0.001	0.017
16b	0.025	0.009	0.003	0.013	**0.050**
17a	0.013	0.010	0.004	0.001	0.029
17b	0.003	0.005	0.007	0.015	0.030
18a	0.003	0.002	0.002	0.003	0.009
18b	0.018	0.015	0.010	0.013	**0.057**
Total	**0.223**	**0.135**	**0.111**	**0.177**	**0.647**
		Alignment Index			**0.68**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.33 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W1 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group W1 to Grade X students at fine grain level is 0.68 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 13c, 16b and 18b (sums of ratio difference ranges from 0.050 to 0.064) are misaligned to the critical level. Similarly, topics 10a, 10b, 12c, and 15b, (sum of ratio difference ranges from 0.040 to 0.048) and STS connection subcategory of cognitive domain (sum of ratio difference is 0.177) are significantly misaligned.

The causes of misalignment are ratio differences up to critical level: (a) with respect to Remember subcategory for the topics 10a, 13c, 15b, and 16b (ratio difference ranges from 0.019 to 0.025), (b) with respect to Understand subcategory for the topics 13c and 18b (ratio difference ranges from 0.015 to 0.021), (c) with respect to skills subcategory for the topics 10a, 13c and 18b (ratio difference ranges from 0.010 to 0.017), and (d) with respect to STS Connection subcategory for the topics 10b, 11b, 12c, 13a, 13c, 14a, 14c, 15a, 15b,16b, 17b, and 18b (ratio difference ranges from 0.006 to 0.024).

Table 4.34

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group W2)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.018	0.001	0.014	0.003	0.036
10b	0.015	0.011	0.002	0.024	**0.051**
11a	0.013	0.010	0.003	0.000	0.026
11b	0.010	0.006	0.010	0.006	0.031
12a	0.020	0.004	0.011	0.005	**0.040**
12b	0.019	0.008	0.001	0.012	**0.040**
12c	0.022	0.005	0.000	0.017	**0.045**
13a	0.017	0.002	0.010	0.006	0.034
13b	0.003	0.003	0.003	0.003	0.011
13c	0.027	0.019	0.003	0.011	**0.060**
14a	0.005	0.002	0.007	0.010	0.024
14b	0.006	0.002	0.009	0.000	0.019
14c	0.012	0.008	0.004	0.008	0.032
15a	0.014	0.001	0.003	0.018	0.037
15b	0.017	0.008	0.001	0.008	0.033
16a	0.007	0.006	0.001	0.001	0.014
16b	0.032	0.010	0.008	0.014	**0.064**
17a	0.012	0.005	0.008	0.000	0.025
17b	0.002	0.010	0.008	0.016	0.035
18a	0.007	0.007	0.002	0.002	0.018
18b	0.022	0.017	0.010	0.014	**0.063**
Total	**0.299**	**0.143**	**0.118**	**0.178**	**0.739**
		Alignment Index			**0.63**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.34 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W2 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group W2 to Grade X students at fine grain level is 0.63 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 13c, 16b and 18b (sums of ratio difference ranges from 0.051 to 0.064) are misaligned to the critical level. Similarly, topics 12a, 12b, and 12c (sum of ratio difference ranges from 0.040 to 0.045) and STS connection subcategory of cognitive domain (sum of ratio difference is 0.178) are significantly misaligned. While Remember and Understand subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.299 and 0.143 respectively).

The causes of misalignment are ratio differences up to critical level: (a) with respect to Remember subcategory for the topics 12a, 12b, 12c, 13c, 16b, and 18b (ratio difference ranges from 0.019 to 0.032), (b) with respect to Understand subcategory for the topics 10b, 13c and 18b (ratio difference ranges from 0.011 to 0.019), (c) with respect to skills subcategory for the topics 10a and 12a (ratio difference ranges from 0.010 to 0.014), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and (ratio difference ranges from 0.010 to 0.024).

Table 4.35

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group W3)

Topic Number	**Ratio Difference with respect to**				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.025	0.001	0.021	0.003	**0.050**
10b	0.030	0.003	0.007	0.026	**0.066**
11a	0.011	0.013	0.001	0.001	0.026
11b	0.017	0.003	0.008	0.006	0.034
12a	0.022	0.010	0.006	0.006	0.043
12b	0.024	0.008	0.005	0.011	0.049
12c	0.027	0.011	0.001	0.017	**0.056**
13a	0.011	0.003	0.003	0.005	0.023
13b	0.007	0.001	0.003	0.005	0.016
13c	0.025	0.019	0.004	0.011	**0.059**
14a	0.020	0.005	0.004	0.011	0.041
14b	0.013	0.004	0.017	0.000	0.034
14c	0.017	0.007	0.002	0.008	0.034
15a	0.016	0.001	0.003	0.018	0.037
15b	0.022	0.008	0.007	0.008	0.045
16a	0.010	0.005	0.003	0.002	0.020
16b	0.034	0.010	0.010	0.014	**0.068**
17a	0.018	0.009	0.010	0.000	0.036
17b	0.008	0.008	0.000	0.016	0.032
18a	0.002	0.001	0.000	0.003	0.006
18b	0.032	0.021	0.005	0.016	**0.074**
Total	**0.390**	**0.150**	**0.118**	**0.188**	**0.847**
		Alignment Index			**0.58**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.35 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W3 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group W3 to Grade X students at fine grain level is 0.58 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10a, 10b, 12b, 12c, 13a, 13c, 16b and 18b (sum of ratio difference ranges from 0.049 to 0.074) and Remember subcategory of cognitive demand (sum of ratio difference is 0.390) are misaligned to the critical level. Similarly, topics 12a, 14a, and 15b (sum of ratio difference ranges from 0.041 to 0.045) and STS connection subcategory of cognitive domain (sum of ratio difference is 0.188) are significantly misaligned. While Understand subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.150).

The causes of misalignment are ratio differences up to critical level: (a) with respect to Remember subcategory for the topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15b, 16b, and 18b (ratio difference ranges from 0.020 to 0.034), (b) with respect to Understand subcategory for the topics 11a, 12c, 13c and 18b (ratio difference ranges from 0.011 to 0.021), (c) with respect to skills subcategory for the topics 10a and 14b (ratio difference ranges from 0.017 to 0.021), and (d) with respect to STS Connection subcategory for the topics 10b, 11b, 12a, 12b, 12c, 13c, 14a, 14c, 15a, 15b, 16b, 17b, and 18b (ratio difference ranges from 0.006 to 0.026).

Table 4.36

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group W4)

Topic Number	Ratio Difference with reference to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.010	0.003	0.011	0.002	**0.026**
10b	0.002	0.004	0.003	0.009	0.018
11a	0.007	0.005	0.002	0.000	0.013
11b	0.007	0.001	0.004	0.002	0.015
12a	0.007	0.003	0.002	0.002	0.013
12b	0.007	0.001	0.003	0.009	0.019
12c	0.011	0.004	0.001	0.009	**0.025**
13a	0.003	0.006	0.003	0.000	0.013
13b	0.008	0.000	0.003	0.005	0.016
13c	0.011	0.005	0.003	0.009	**0.029**
14a	0.010	0.002	0.000	0.008	0.020
14b	0.002	0.004	0.006	0.001	0.013
14c	0.003	0.002	0.004	0.005	0.015
15a	0.006	0.002	0.004	0.009	0.021
15b	0.002	0.004	0.003	0.005	0.014
16a	0.008	0.004	0.003	0.002	0.016
16b	0.014	0.004	0.003	0.006	**0.028**
17a	0.009	0.003	0.006	0.000	0.018
17b	0.007	0.011	0.000	0.005	0.023
18a	0.003	0.004	0.000	0.001	0.008
18b	0.020	0.009	0.000	0.012	**0.040**
Total	**0.155**	**0.081**	**0.066**	**0.099**	**0.402**
		Alignment Index			**0.80**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.36 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group W4 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group W4 to Grade X students at fine grain level is 0.80 which reflects a significant alignment level. The sum of ratio difference between written curriculum and the curriculum taught by Group W4 to Grade X students ranges from 0.008 to 0.040. The topics 12a, 12c, 13c, 16b, and 18b are comparatively less aligned (sum of ratio difference ranges from 0.025 to 0.040). On the other hand, the topics 10b, 11a, 11b, 12a, 13a, 14b, 14c, 15b, and 18a are comparatively more aligned (sum of ratio difference ranges from 0.008to 0.015). As for as the sub categories of cognitive demand are concerned, the subcategory Remember is comparatively more misaligned (sum of ratio differences 0.155) than the other subcategories.

Table 4.37

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group X1)

Topic	Ratio Difference with reference to				
Number	**Remember13**	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.014	0.011	0.004	0.006	0.035
1b	0.016	0.005	0.011	0.001	0.033
2a	0.024	0.004	0.020	0.000	**0.049**
3a	0.014	0.002	0.001	0.012	0.028
3b	0.019	0.005	0.006	0.009	0.039
4a	0.027	0.007	0.005	0.016	**0.055**
4b	0.027	0.019	0.009	0.001	**0.056**
4c	0.011	0.003	0.009	0.005	0.028
4d	0.019	0.004	0.004	0.012	0.039
5a	0.009	0.002	0.007	0.000	0.019
5b	0.010	0.011	0.004	0.002	0.026
6a	0.006	0.006	0.001	0.001	0.014
6b	0.020	0.015	0.007	0.002	**0.043**
7a	0.010	0.003	0.008	0.001	0.022
7b	0.012	0.013	0.002	0.003	0.030
8a	0.019	0.009	0.003	0.007	0.037
8b	0.003	0.000	0.006	0.003	0.011
9a	0.025	0.010	0.016	0.001	**0.052**
9b	0.004	0.000	0.000	0.003	0.008
Total	**0.290**	**0.130**	**0.122**	**0.083**	**0.625**
		Alignment Index			**0.69**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.37 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X1 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group X1 to Grade

IX students at fine grain level is 0.69 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 4a and 4b (sums of ratio difference are from 0.055 are 0.056) are misaligned to the critical level. The topics 2a, 6b, and 9a (sums of ratio difference ranges from 0.043 to 0.052) and STS connection subcategory of cognitive demand (sum of ratio difference is 0.083) are misaligned to the significant level.

The causes of misalignment are ratio differences up to critical level: (a) with respect to Remember subcategory for the topics 2a, 4a, 4b, 4d, 6b, and 18a (ratio difference ranges from 0.019 to 0.027), (b) with respect to Understand subcategory for the topics 1a, 5b, and 7b (ratio difference ranges from 0.011 to 0.013), (c) with respect to skills subcategory for the topics 2a and 9a (ratio differences are 0.020 to 0.016 respectively), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, and 8a (ratio difference ranges from 0.006 to 0.016).

Table 4.38

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group X2)

Topic	Ratio Difference with respect to				
Number	**Remember13**	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.021	0.011	0.000	0.011	0.043
1b	0.014	0.007	0.008	0.001	0.029
2a	0.033	0.004	0.031	0.002	**0.070**
3a	0.025	0.006	0.007	0.012	0.049
3b	0.026	0.002	0.016	0.008	**0.052**
4a	0.026	0.005	0.006	0.015	**0.053**
4b	0.033	0.011	0.023	0.001	**0.068**
4c	0.017	0.005	0.020	0.003	0.045
4d	0.031	0.003	0.014	0.014	**0.063**
5a	0.012	0.001	0.012	0.000	0.025
5b	0.017	0.009	0.005	0.003	0.034
6a	0.011	0.004	0.007	0.000	0.022
6b	0.027	0.014	0.015	0.002	**0.058**
7a	0.008	0.000	0.008	0.000	0.016
7b	0.015	0.009	0.007	0.002	0.032
8a	0.014	0.010	0.001	0.006	0.031
8b	0.001	0.002	0.001	0.002	0.006
9a	0.017	0.012	0.006	0.001	0.035
9b	0.005	0.008	0.006	0.006	0.024
Total	**0.352**	**0.121**	**0.194**	**0.088**	**0.755**
		Alignment Index			**0.62**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.38 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X2 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group X2 to Grade

IX students at fine grain level is 0.62 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 4b, 4d and 6b (sum of ratio difference ranges from 0.058 are 0.070) are misaligned to the critical level. The topics 1a, 3a, 3b, and 4a (sum of ratio difference ranges from 0.043 to 0.053) and Remember and STS connection subcategories of cognitive demand (sums of ratio difference are 0.352 and 0.088 respectively) are misaligned to the significant level.

The misalignment between written curriculum and the curriculum taught by Group X2 to Grade IX students is due to ratio differences (a) with respect to Remember subcategory for the topics 2a, 3a, 3b, 4a, 4b, 4d, and 6b (ratio difference ranges from 0.025 to 0.033), (b) with respect to skills subcategory for the topics 2a, 3b, 4b, and 4c (ratio differences ranges from 0.016 to 0.031), and (c) with respect to STS Connection subcategory for the topics 1a, 3a, 4a, 4d, 8a, and 9b (ratio difference ranges from 0.006 to 0.015).

Table 4.39

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group X3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.027	0.017	0.000	0.010	**0.053**
1b	0.024	0.008	0.016	0.001	0.049
2a	0.041	0.008	0.034	0.001	**0.083**
3a	0.026	0.007	0.007	0.012	**0.052**
3b	0.031	0.005	0.016	0.011	**0.062**
4a	0.033	0.011	0.006	0.016	**0.066**
4b	0.039	0.018	0.021	0.000	**0.079**
4c	0.023	0.002	0.018	0.004	0.047
4d	0.032	0.005	0.013	0.014	**0.065**
5a	0.017	0.003	0.014	0.000	0.034
5b	0.023	0.013	0.006	0.004	0.046
6a	0.012	0.003	0.008	0.000	0.023
6b	0.033	0.016	0.017	0.001	**0.066**
7a	0.014	0.001	0.013	0.001	0.028
7b	0.018	0.012	0.007	0.001	0.038
8a	0.022	0.013	0.005	0.004	0.045
8b	0.003	0.000	0.001	0.004	0.008
9a	0.024	0.011	0.015	0.002	**0.051**
9b	0.010	0.000	0.005	0.005	0.021
Total	**0.452**	**0.153**	**0.224**	**0.088**	**0.917**
		Alignment Index			**0.54**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.39 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X3 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group X3 to Grade

IX students at fine grain level is 0.54 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 3b, 4a, 4b, 4d, and 6b (sum of ratio difference ranges from 0.065 to 0.083) and Remember subcategory of cognitive demand (sum of ratio difference is 0.452) are misaligned to the critical level. The topics 1a, 1b, 3a, 4c, 5b, 8a, and 9a (sum of ratio difference ranges from 0.045 to 0.053) and Skills and STS connection subcategories of cognitive demand (sums of ratio difference are 0.224 and 0.088 respectively) are misaligned to the significant level.

The misalignment between written curriculum and the curriculum taught by Group X3 to Grade IX students is due to ratio differences (a) with respect to Remember subcategory for all the topics except 5a, 6a, 7a, 7b, 8b, and 9b (ratio difference ranges from 0.022 to 0.041), (b) with respect to Understand subcategory for the topics 1a, 4b, and 6b (ratio differences ranges from 0.016 to 0.018), (c) with respect to skills subcategory for the topics 1b, 2a, 3b, 4b, 4c, 6b, and 9a (ratio differences ranges from 0.015 to 0.034), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, and 4d (ratio difference ranges from 0.010 to 0.016).

Table 4.40

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group X4)

Topic	Ratio Difference with respect to				
Number	**Remember13**	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.006	0.005	0.000	0.001	0.012
1b	0.007	0.001	0.008	0.000	0.015
2a	0.018	0.001	0.017	0.000	**0.035**
3a	0.009	0.001	0.002	0.007	0.018
3b	0.011	0.001	0.008	0.002	0.022
4a	0.013	0.001	0.002	0.010	0.025
4b	0.022	0.010	0.012	0.001	**0.045**
4c	0.010	0.005	0.013	0.002	0.030
4d	0.017	0.001	0.006	0.010	0.033
5a	0.007	0.001	0.007	0.002	0.017
5b	0.008	0.005	0.002	0.001	0.017
6a	0.005	0.002	0.005	0.002	0.015
6b	0.015	0.009	0.009	0.003	**0.037**
7a	0.004	0.002	0.005	0.003	0.015
7b	0.007	0.006	0.003	0.002	0.017
8a	0.010	0.005	0.001	0.003	0.019
8b	0.004	0.001	0.001	0.002	0.008
9a	0.017	0.007	0.011	0.001	**0.036**
9b	0.009	0.002	0.003	0.004	0.017
Total	**0.198**	**0.067**	**0.116**	**0.054**	**0.435**
		Alignment Index			**0.78**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.40 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X4 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group X4 to Grade

IX students at fine grain level is 0.78 which reflects a considerable alignment level. However, degree of alignment is different for different topics and subcategories. The topics 2a, 4b, 6b, and 9a are comparatively less aligned (sum of ratio difference ranges from 0.035 to 0.045). On the other hand, topics 1a, 1b, 6a, 7a, 8b, and C9b are comparatively more aligned (sum of ratio difference ranges from 0.008 to 0.015). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Understand are comparatively more misaligned (sum of ratio differences are 0.352 and 0.121) than the other subcategories.

Table 4.41

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group X1)

Topic Number	Ratio Difference with respect to				
	Remember13	Understand13	Skills13	STS13	Total
10a	0.014	0.001	0.010	0.003	0.028
10b	0.018	0.008	0.002	0.024	**0.051**
11a	0.006	0.009	0.001	0.003	0.019
11b	0.012	0.001	0.005	0.006	0.024
12a	0.016	0.004	0.007	0.005	0.032
12b	0.020	0.007	0.003	0.010	0.039
12c	0.020	0.006	0.001	0.014	**0.042**
13a	0.010	0.002	0.004	0.005	0.021
13b	0.004	0.001	0.002	0.005	0.013
13c	0.014	0.016	0.011	0.009	**0.050**
14a	0.014	0.007	0.003	0.010	0.034
14b	0.012	0.002	0.011	0.001	0.026
14c	0.016	0.005	0.002	0.009	0.032
15a	0.010	0.002	0.009	0.016	0.037
15b	0.014	0.005	0.002	0.007	0.028
16a	0.005	0.006	0.002	0.001	0.014
16b	0.024	0.010	0.002	0.011	**0.048**
17a	0.011	0.010	0.003	0.002	0.027
17b	0.007	0.002	0.006	0.016	0.032
18a	0.004	0.001	0.000	0.003	0.007
18b	0.027	0.014	0.000	0.013	**0.054**
Total	**0.277**	**0.118**	**0.086**	**0.176**	**0.657**
		Alignment Index			**0.67**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.41 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X1 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group X1 to Grade X students at fine grain level is 0.67 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 13c, and 18b (sum of ratio difference ranges from 0.050 to 0.054) are misaligned to the critical level. Similarly, topics 12b, 12c, and 16b (sum of ratio difference ranges from 0.039 to 0.048) and STS connection subcategory of cognitive domain (sum of ratio difference is 0.176) are significantly misaligned. While Remember subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.277).

The misalignment between the written curriculum and curriculum taught by Group X1 to Grade X students is due to ratio differences (a) with respect to Remember subcategory for the topics 12b, 12c, 16b, and 18b (ratio difference ranges from 0.020 to 0.027), (b) with respect to Understand subcategory for the topics 13c and 18b misaligned (ratio difference ranges from 0.014 to 0.016), (c) with respect to skills subcategory for the topics 13c and 14b (ratio difference range is 0.011), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.024).

Table 4.42

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group X2)

Topic Number	Ratio Difference with respect to				
	Remember13	Understand13	Skills13	STS13	Total
10a	0.022	0.002	0.018	0.003	0.044
10b	0.019	0.008	0.003	0.025	**0.055**
11a	0.015	0.011	0.004	0.000	0.030
11b	0.011	0.003	0.004	0.005	0.022
12a	0.022	0.006	0.010	0.005	0.043
12b	0.022	0.009	0.003	0.010	0.045
12c	0.025	0.009	0.000	0.016	**0.050**
13a	0.018	0.002	0.010	0.005	0.035
13b	0.009	0.002	0.002	0.004	0.019
13c	0.021	0.016	0.006	0.011	**0.055**
14a	0.015	0.005	0.000	0.009	0.029
14b	0.009	0.001	0.009	0.001	0.021
14c	0.011	0.008	0.004	0.008	0.031
15a	0.017	0.002	0.003	0.018	0.040
15b	0.019	0.005	0.006	0.008	0.038
16a	0.010	0.007	0.001	0.003	0.021
16b	0.030	0.009	0.008	0.014	**0.061**
17a	0.014	0.007	0.008	0.000	0.029
17b	0.005	0.003	0.008	0.016	0.032
18a	0.001	0.002	0.002	0.001	0.006
18b	0.024	0.015	0.004	0.013	**0.057**
Total	**0.341**	**0.132**	**0.115**	**0.175**	**0.763**
		Alignment Index			**0.62**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.42 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X2 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group X2 to Grade X students at fine grain level is 0.62 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 12c, 13c, 16b and 18b (sum of ratio difference ranges from 0.050 to 0.061) are misaligned to the critical level. Similarly, topics 10a, 12a, 12b, and 15a (sum of ratio difference ranges from 0.040 to 0.045) and Remember and STS connection subcategories of cognitive domain (sums of ratio difference are 0.341 and 0.175 respectively) are significantly misaligned. While Understand subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.132).

The misalignment between the written curriculum and curriculum taught by Group X2 to Grade X students is due to ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 12a, 12b, 12c, 13c, 15b, 16b, and 18b (ratio difference ranges from 0.019 to 0.030), (b) with respect to Understand subcategory for the topics 11a, 13c and 18b (ratio difference ranges from 0.011 to 0.016), (c) with respect to skills subcategory for the topic 10a (ratio difference is 0.018), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 13c, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.025).

Table 4.43

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group X3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.024	0.003	0.018	0.003	0.048
10b	0.031	0.004	0.008	0.026	**0.069**
11a	0.013	0.013	0.002	0.001	0.029
11b	0.016	0.003	0.007	0.006	0.033
12a	0.024	0.009	0.009	0.005	0.048
12b	0.024	0.007	0.008	0.009	0.048
12c	0.028	0.011	0.001	0.017	**0.057**
13a	0.013	0.003	0.006	0.005	0.027
13b	0.014	0.002	0.006	0.005	0.027
13c	0.024	0.020	0.006	0.010	**0.060**
14a	0.022	0.006	0.005	0.012	0.044
14b	0.019	0.001	0.018	0.000	0.038
14c	0.019	0.008	0.004	0.008	0.039
15a	0.018	0.003	0.001	0.016	0.039
15b	0.026	0.010	0.007	0.009	**0.052**
16a	0.012	0.007	0.003	0.002	0.025
16b	0.036	0.012	0.010	0.014	**0.072**
17a	0.021	0.011	0.010	0.000	0.042
17b	0.012	0.004	0.000	0.016	0.032
18a	0.001	0.002	0.000	0.003	0.006
18b	0.034	0.021	0.003	0.016	**0.075**
Total	**0.433**	**0.161**	**0.130**	**0.184**	**0.909**
		Alignment Index			**0.55**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.43 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X3 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group X3 to Grade X students at fine grain level is 0.55 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 12c, 13c, 15b, 16b, and 18b (sum of ratio difference ranges from 0.052 to 0.075) and Remember subcategory of cognitive demand (sum of ratio difference is 0.433) are misaligned to the critical level. Similarly, topics 10a, 12a, 12b, 14a, 14c, 15a, and 17a (sum of ratio difference ranges from 0.039 to 0.048) and STS connection subcategory of cognitive domain (sum of ratio difference is 0.184) are significantly misaligned. While Understand subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.161).

The misalignment between the written curriculum and curriculum taught by Group X3 to Grade X students is due to ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 14b, 14c, 15b, 16b, 17a, and 18b (ratio difference ranges from 0.019 to 0.034), (b) with respect to Understand subcategory for the topics 11a, 13c, 16b, 17a, and 18b (ratio difference ranges from 0.011 to 0.021), (c) with respect to skills subcategory for the topics 10a and 14b (ratio difference range is 0.018), and (d) with respect to STS Connection subcategory for the topics 10b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.026).

Table 4.44

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group X4)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.013	0.002	0.010	0.002	0.027
10b	0.012	0.004	0.002	0.014	**0.033**
11a	0.007	0.005	0.002	0.000	0.013
11b	0.009	0.001	0.005	0.003	0.018
12a	0.009	0.003	0.004	0.002	0.018
12b	0.013	0.003	0.002	0.008	0.026
12c	0.013	0.005	0.002	0.011	**0.031**
13a	0.011	0.001	0.008	0.002	0.022
13b	0.012	0.001	0.007	0.003	0.023
13c	0.011	0.011	0.010	0.010	**0.043**
14a	0.012	0.004	0.001	0.007	0.024
14b	0.016	0.001	0.015	0000	**0.033**
14c	0.008	0.005	0.000	0.003	0.018
15a	0.014	0.002	0.003	0.015	**0.034**
15b	0.010	0.005	0.004	0.000	0.019
16a	0.010	0.005	0.003	0.002	0.021
16b	0.017	0.008	0.002	0.007	**0.033**
17a	0.011	0.007	0.004	0000	0.022
17b	0.003	0.005	0000	0.008	0.016
18a	0.004	0.001	0000	0.003	0.008
18b	0.023	0.013	0000	0.010	**0.046**
Total	**0.239**	**0.093**	**0.085**	**0.110**	**0.528**
		Alignment Index			**0.74**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.44 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group X4 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group X4 to Grade X students at fine grain level is 0.74 which reflects a considerable alignment level. However, degree of alignment is different for different topics and subcategories. The topics 10b, 12c, 13c, 14b, 15a, 16a, and 18b are comparatively less aligned (sum of ratio difference ranges from 0.031 to 0.046). On the other hand, topics 11a and 18a are comparatively more aligned (sum of ratio difference ranges from 0.008 to 0.013). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Understand are comparatively less aligned (sum of ratio differences are 0.239 and 0.093) than the other subcategories.

Table 4.45

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Y1)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.020	0.010	0.000	0.010	0.040
1b	0.021	0.007	0.016	0.002	0.046
2a	0.035	0.006	0.031	0.002	**0.074**
3a	0.019	0.003	0.004	0.013	0.039
3b	0.023	0.006	0.007	0.009	0.046
4a	0.031	0.011	0.005	0.015	**0.062**
4b	0.032	0.018	0.016	0.002	**0.068**
4c	0.018	0.002	0.014	0.002	0.035
4d	0.028	0.005	0.009	0.014	**0.056**
5a	0.008	0.003	0.007	0.002	0.020
5b	0.015	0.011	0.001	0.003	0.031
6a	0.010	0.005	0.006	0.001	0.023
6b	0.024	0.013	0.014	0.002	0.053
7a	0.010	0.005	0.008	0.003	0.024
7b	0.018	0.014	0.006	0.002	0.040
8a	0.015	0.010	0.001	0.003	0.030
8b	0.001	0.001	0.002	0.002	0.006
9a	0.024	0.011	0.015	0.002	**0.053**
9b	0.004	0.004	0.003	0.005	0.016
Total	**0.357**	**0.145**	**0.165**	**0.093**	**0.760**
		Alignment Index			**0.62**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.45 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y1 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y1 to Grade IX students at fine grain level is 0.62 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 4a, 4b, and 4d (sum of ratio difference ranges from 0.056 are 0.074) and STS connection subcategories of cognitive demand (sums of ratio difference 0.093) are misaligned to the critical level. The topics 1b, 3b, 6b, and 9a (sum of ratio difference ranges from 0.046 to 0.053) and Remember subcategory of cognitive demand (0.357 and 0.088 respectively) are misaligned to the significant level.

The misalignment between written curriculum and the curriculum taught by Group Y1 to Grade IX students is due to ratio differences: (a) with respect to Remember subcategory for the topics 1a, 1b, 2a, 3b, 4a, 4b, 4d, 6b, and 9a (ratio difference ranges from 0.020 to 0.035), (b) with respect to Understand subcategory for the topics 4b and 7b (ratio differences are 0.014 and 0.018), (c) skills subcategory for the topics 1b, 2a, 4b, and 9a (ratio differences ranges from 0.015 to 0.031), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, and 4d, (ratio difference ranges from 0.009 to 0.015).

Table 4.46

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Y2)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.026	0.015	0	0.011	**0.051**
1b	0.013	0.007	0.008	0.002	0.031
2a	0.039	0.008	0.033	0.003	**0.082**
3a	0.024	0.005	0.007	0.011	0.047
3b	0.031	0.007	0.014	0.010	**0.062**
4a	0.029	0.008	0.007	0.015	**0.059**
4b	0.036	0.018	0.020	0.002	**0.076**
4c	0.023	0.000	0.020	0.004	0.047
4d	0.031	0.006	0.012	0.013	**0.063**
5a	0.011	0.000	0.012	0.002	0.025
5b	0.018	0.014	0.003	0.002	0.037
6a	0.010	0.004	0.008	0.001	0.023
6b	0.031	0.016	0.016	0.001	**0.063**
7a	0.007	0.001	0.009	0.003	0.019
7b	0.020	0.014	0.007	0.002	0.043
8a	0.018	0.010	0.002	0.006	0.035
8b	0.003	0.003	0.003	0.003	0.012
9a	0.023	0.010	0.014	0.001	0.048
9b	0.003	0.005	0.003	0.006	0.018
Total	**0.397**	**0.151**	**0.198**	**0.096**	**0.841**
		Alignment Index			**0.58**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.46 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y2 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y2 to Grade

IX students at fine grain level is 0.58 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 3b, 4a, 4b, 4d, and 6b (sum of ratio difference ranges from 0.059 are 0.082) and STS connection subcategory of cognitive demand (sum of ratio difference is 0.096) are misaligned to the critical level. The topics 1a, 3a, 4c, 7b, and 9a (sum of ratio difference ranges from 0.044 to 0.051) and Remember subcategory of cognitive demand (sum of ratio difference is 0.397) are misaligned to the significant level.

The misalignment between written curriculum and the curriculum taught by Group Y2 to Grade IX students is due to ratio differences: (a) with respect to Remember subcategory for the topics 1a, 2a, 3a, 3b, 4a, 4b, 4c, 4d, 6b, and 9a (ratio difference ranges from 0.023 to 0.039), (b) with respect to Understand subcategory for the topics 1a, 4b, 5b, 6b, and 7b (ratio differences ranges from 0.014 to 0.018), (c) with respect to skills subcategory for the topics 2a, 4b, 4c, and 6b (ratio differences ranges from 0.016 to 0.033), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, 4d, 8a, and 9b (ratio difference ranges from 0.006 to 0.015).

Table 4.47

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Y3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.027	0.017	0.000	0.011	**0.054**
1b	0.019	0.007	0.016	0.004	0.046
2a	0.037	0.008	0.032	0.003	**0.080**
3a	0.024	0.006	0.007	0.011	0.048
3b	0.029	0.008	0.014	0.008	**0.059**
4a	0.031	0.011	0.007	0.013	**0.061**
4b	0.035	0.020	0.019	0.003	**0.077**
4c	0.029	0.003	0.021	0.005	**0.059**
4d	0.029	0.007	0.014	0.008	**0.059**
5a	0.007	0.003	0.014	0.009	0.034
5b	0.022	0.017	0.003	0.002	0.043
6a	0.012	0.011	0.011	0.011	0.045
6b	0.027	0.017	0.019	0.009	**0.073**
7a	0.013	0.006	0.011	0.004	0.035
7b	0.020	0.014	0.009	0.003	0.046
8a	0.021	0.011	0.005	0.006	0.041
8b	0.005	0.000	0.002	0.003	0.010
9a	0.029	0.014	0.019	0.004	**0.067**
9b	0.018	0.004	0.008	0.006	0.036
Total	**0.435**	**0.184**	**0.231**	**0.123**	**0.973**
		Alignment Index			**0.51**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.47 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y3 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y3 to Grade IX students at fine grain level is 0.51 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 1a, 2a, 3b, 4a, 4b, 4c, 4d, 6b, and 9a (sum of ratio difference ranges from 0.054 are 0.080) and Remember and STS connection subcategories of cognitive demand (sums of ratio difference are 0.435 and 0.123 respectively) are misaligned to the critical level. The topics 1b, 3a, 5b, 6a, and 7b (sum of ratio difference ranges from 0.043 to 0.048) are misaligned to the significant level. Understand and Skills subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.184 and 0.231 respectively)

The misalignment between the written curriculum and curriculum taught by Group Y3 to Grade IX students is due to ratio differences: (a) with respect to Remember subcategory for all the topics (except 5a, 6a, 7a, 7b, 8a, 8b, and 9b) (ratio difference ranges from 0.019 to 0.037), (b) with respect to Understand subcategory for the topics 1a, 4b, 5b, 6b, 7b, and 9a (ratio differences ranges from 0.014 to 0.020), (c) with respect to skills subcategory for the topics 1b, 2a, 4b, 4c, 6b, and 9a (ratio differences ranges from 0.014 to 0.032), and (d) with respect to STS Connection subcategory for the topics 1a, 3a, 3b, 4a, 4d, 5a, 6b, 8a, and 9b (ratio difference ranges from 0.006 to 0.013).

Table 4.48

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Y4)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.006	0.011	0.007	0.002	0.026
1b	0.008	0.001	0.010	0.003	0.022
2a	0.014	0.000	0.017	0.003	**0.035**
3a	0.008	0.005	0.006	0.007	0.026
3b	0.012	0.003	0.004	0.005	0.023
4a	0.007	0.001	0.002	0.009	0.019
4b	0.020	0.012	0.012	0.004	**0.048**
4c	0.008	0.003	0.011	0.000	0.023
4d	0.010	0.004	0.005	0.009	0.028
5a	0.006	0.002	0.007	0.004	0.019
5b	0.008	0.007	0.003	0.001	0.019
6a	0.007	0.005	0.007	0.006	0.025
6b	0.012	0.007	0.009	0.005	**0.034**
7a	0.003	0.001	0.008	0.006	0.018
7b	0.009	0.008	0.006	0.005	0.028
8a	0.010	0.006	0.000	0.003	0.019
8b	0.008	0.006	0.001	0.001	0.017
9a	0.011	0.008	0.011	0.008	**0.038**
9b	0.010	0.001	0.004	0.004	0.020
Total	**0.177**	**0.091**	**0.132**	**0.086**	**0.486**
		Alignment Index			**0.76**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.48 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y4 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y4 to Grade

IX students at fine grain level is 0.76 which reflects a considerable alignment level. However, degree of alignment is different for different topics and subcategories. The topics 2a, 4b, 6b, and 9a are comparatively less aligned (sum of ratio difference ranges from 0.034 to 0.048). On the other hand, topics 4a, 5a, 5b, 7a, 8a and 8b are comparatively more aligned (sum of ratio difference ranges from 0.017 to 0.019). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Skills are comparatively less aligned (sum of ratio differences are 0.177 and 0.132) than the other subcategories.

Table 4.49

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Y1)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.020	0.002	0.016	0.003	0.041
10b	0.023	0.008	0.005	0.026	**0.061**
11a	0.008	0.012	0.004	0.001	0.024
11b	0.015	0.003	0.006	0.005	0.029
12a	0.018	0.006	0.007	0.004	0.036
12b	0.021	0.006	0.004	0.011	0.042
12c	0.020	0.006	0.002	0.016	0.044
13a	0.008	0.001	0.004	0.003	0.015
13b	0.010	0.001	0.003	0.005	0.019
13c	0.022	0.016	0.005	0.010	**0.053**
14a	0.015	0.003	0.002	0.010	0.030
14b	0.015	0.002	0.014	0.000	0.032
14c	0.017	0.006	0.003	0.007	0.034
15a	0.013	0.002	0.004	0.015	0.034
15b	0.019	0.005	0.006	0.008	0.038
16a	0.010	0.006	0.002	0.002	0.020
16b	0.026	0.011	0.003	0.012	**0.052**
17a	0.013	0.009	0.005	0.001	0.028
17b	0.005	0.007	0.002	0.015	0.030
18a	0.003	0.002	0.002	0.003	0.009
18b	0.026	0.015	0.001	0.013	**0.056**
Total	**0.327**	**0.128**	**0.103**	**0.170**	**0.728**
		Alignment Index			**0.64**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.49 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y1 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y1 to Grade IX students at fine grain level is 0.64 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 13c, 16b and 18b (sum of ratio difference ranges from 0.052 to 0.061) are misaligned to the critical level. Similarly, topics 10a, 12b, and 12c, (sum of ratio difference ranges from 0.041 to 0.044) and Remember (sum of ratio difference is 0.327) and STS connection (sum of ratio difference is 0.170) subcategories of cognitive domain are significantly misaligned. While Understand subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.128).

The misalignment between the written curriculum and curriculum taught by Group Y1 to Grade X students is due to ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 12b, 13c, 15b, 16b, and 18b (ratio difference ranges from 0.019 to 0.026), (b) with respect to Understand subcategory for the topics 11a, 13c, 16b, and 18b (ratio difference ranges from 0.011 to 0.016), (c) with respect to skills subcategory for the topics 10a and 14b (ratio difference are 0.016 and 0.014), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.026).

Table 4.50

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Y2)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.024	0.001	0.021	0.003	0.049
10b	0.019	0.006	0.002	0.024	**0.051**
11a	0.018	0.015	0.003	0.000	0.036
11b	0.014	0.002	0.010	0.006	0.031
12a	0.022	0.006	0.011	0.005	0.043
12b	0.023	0.008	0.003	0.012	0.047
12c	0.022	0.005	0.000	0.017	0.045
13a	0.017	0.002	0.010	0.006	0.034
13b	0.007	0.002	0.002	0.003	0.014
13c	0.027	0.019	0.003	0.011	**0.060**
14a	0.022	0.007	0.005	0.010	0.043
14b	0.015	0.000	0.016	0.000	0.032
14c	0.016	0.008	0.001	0.008	0.033
15a	0.014	0.001	0.003	0.018	0.037
15b	0.017	0.008	0.001	0.008	0.033
16a	0.007	0.006	0.001	0.001	0.014
16b	0.032	0.010	0.008	0.014	**0.064**
17a	0.012	0.005	0.008	0.000	0.025
17b	0.002	0.010	0.008	0.016	0.035
18a	0.007	0.007	0.002	0.002	0.018
18b	0.022	0.017	0.010	0.014	**0.063**
Total	**0.360**	**0.142**	**0.127**	**0.178**	**0.808**
		Alignment Index			**0.60**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.50 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y2 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y2 to Grade X students at fine grain level is 0.60 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10a, 10b, 13c, 16b and 18b (sum of ratio difference ranges from 0.051 to 0.064) are misaligned to the critical level. Similarly, topics 12a, 12b, 12c, and 14a (sum of ratio difference ranges from 0.043 to 0.047), and Remember (sum of ratio difference is 0.360) and STS connection subcategories of cognitive domain (sum of ratio difference is 0.178) are significantly misaligned. While Understand (sum of ratio difference is 0.142) and Skills (sum of ratio difference is 0.127) subcategories of cognitive demand is considerably misaligned.

The misalignment between the written curriculum and curriculum taught by Group Y2 to Grade X students is due to ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 16b, and 18b (ratio difference ranges from 0.019 to 0.032), (b) with respect to Understand subcategory for the topics 11a, 13c and 18b (ratio difference ranges from 0.015 to 0.019), (c) with respect to skills subcategory for the topics 10a, 12a, and 14b are critically misaligned (ratio difference ranges from 0.011 to 0.021), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.024).

Table 4.51

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Y3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.027	0.001	0.023	0.003	**0.053**
10b	0.030	0.003	0.007	0.026	**0.066**
11a	0.014	0.014	0.001	0.001	0.030
11b	0.019	0.004	0.010	0.006	0.039
12a	0.023	0.009	0.008	0.006	0.045
12b	0.030	0.008	0.010	0.011	**0.059**
12c	0.031	0.011	0.004	0.016	**0.062**
13a	0.016	0.003	0.008	0.005	0.032
13b	0.016	0.003	0.008	0.005	0.032
13c	0.030	0.020	0.002	0.012	**0.065**
14a	0.032	0.012	0.008	0.012	**0.063**
14b	0.016	0.001	0.017	0.002	0.038
14c	0.022	0.009	0.006	0.007	0.043
15a	0.029	0.007	0.004	0.018	**0.059**
15b	0.035	0.013	0.013	0.009	**0.070**
16a	0.014	0.008	0.003	0.002	0.028
16b	0.033	0.010	0.010	0.013	**0.066**
17a	0.014	0.010	0.007	0.004	0.035
17b	0.003	0.010	0.001	0.015	0.030
18a	0.001	0.001	0.002	0.004	0.008
18b	0.035	0.022	0.003	0.016	**0.076**
Total	**0.469**	**0.181**	**0.154**	**0.194**	**0.998**
		Alignment Index			**0.50**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.51 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y3 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y3 to Grade X students at fine grain level is 0.50 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15a, 15b, 16b and 18b (sum of ratio difference ranges from 0.050 to 0.076) as well as Remember (sum of ratio difference is 0.469) and STS connection (sum of ratio difference is 0.194) subcategories of cognitive demand are misaligned to the critical level. Similarly, topics 11b, 12a, and 14c (sum of ratio difference ranges from 0.039 to 0.045) are significantly misaligned. While Understand and Skills subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.181 and 0.154 respectively).

The misalignment between the written curriculum and curriculum taught by Group Y3 to Grade X students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 11a, 11b, 12a, 12b, 12c, 13c, 14a, 15b, 16b, and 18b (ratio difference ranges from 0.019 to 0.035), (b) with respect to Understand subcategory for the topics 11a, 12c, 13c and 18b (ratio difference ranges from 0.011 to 0.022), (c) with respect to skills subcategory for the topic 14b (ratio difference is 0.017), and (d) with respect to STS Connection subcategory for the topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.011 to 0.026).

Table 4.52

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Y4)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.014	0.002	0.013	0.002	**0.031**
10b	0.015	0.004	0.002	0.016	**0.038**
11a	0.008	0.007	0.002	0.001	0.018
11b	0.007	0.002	0.003	0.003	0.015
12a	0.010	0.004	0.004	0.003	0.021
12b	0.011	0.004	0.000	0.007	0.022
12c	0.014	0.006	0.003	0.011	**0.034**
13a	0.006	0.002	0.004	0.001	0.012
13b	0.005	0.002	0.004	0.003	0.016
13c	0.013	0.010	0.006	0.009	**0.038**
14a	0.017	0.005	0.003	0.008	**0.033**
14b	0.004	0.004	0.012	0.004	0.023
14c	0.016	0.006	0.003	0.006	0.031
15a	0.009	0.003	0.004	0.011	0.027
15b	0.010	0.004	0.004	0.002	0.020
16a	0.008	0.004	0.003	0.002	0.016
16b	0.015	0.005	0.001	0.008	**0.030**
17a	0.006	0.003	0.004	0.001	0.014
17b	0.004	0.007	0.000	0.003	0.013
18a	0.001	0.001	0.000	0.001	0.003
18b	0.016	0.010	0.000	0.007	**0.034**
Total	**0.209**	**0.094**	**0.077**	**0.108**	**0.488**
		Alignment Index			**0.76**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.52 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Y4 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Y4 to Grade X students at fine grain level is 0.76 which reflects a considerable alignment level. However, degree of alignment is different for different topics and subcategories. The topics 10a, 10b, 12c, 13c, 14a, 16b, and 18b are comparatively less aligned (sum of ratio difference ranges from 0.030 to 0.038). On the other hand, topics 11b, 13a, 17a, 17b, and 18a are comparatively more aligned (sum of ratio difference ranges from 0.003 to 0.015). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and STS Connection are comparatively more misaligned (sum of ratio differences are 0.209 and 0.108 respectively) than the other subcategories.

Table 4.53

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Z1)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.011	0.013	0.014	0.012	**0.050**
1b	0.012	0.008	0.013	0.010	0.044
2a	0.024	0.006	0.029	0.012	**0.071**
3a	0.021	0.007	0.004	0.009	0.041
3b	0.022	0.005	0.007	0.010	0.043
4a	0.026	0.010	0.002	0.014	**0.052**
4b	0.021	0.015	0.012	0.006	**0.055**
4c	0.014	0.002	0.009	0.004	0.028
4d	0.022	0.005	0.004	0.013	0.045
5a	0.002	0.003	0.005	0.006	0.016
5b	0.016	0.010	0.002	0.004	0.032
6a	0.006	0.007	0.004	0.005	0.021
6b	0.018	0.013	0.009	0.005	0.045
7a	0.004	0.005	0.007	0.007	0.023
7b	0.012	0.012	0.005	0.006	0.035
8a	0.015	0.007	0.003	0.005	0.030
8b	0.007	0.002	0.003	0.002	0.015
9a	0.014	0.006	0.013	0.004	0.036
9b	0.002	0.010	0.003	0.005	0.020
Total	**0.268**	**0.147**	**0.149**	**0.137**	**0.701**
		Alignment Index			**0.65**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.53 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z1 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z1 to Grade IX students at fine grain level is 0.65 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, and 4b (sums of ratio difference are 0.071 and 0.055) and STS connection subcategory of cognitive demand (sum of ratio difference is 0.137) are misaligned to the critical level. The topics 1a, 1b, 3b, 4a, 4d, and 6b (sum of ratio difference ranges from 0.044 to 0.052) are misaligned to the significant level. Remember and Understand subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.268 and 0.147 respectively)

The misalignment between the written curriculum and curriculum taught by Group Z1 to Grade IX students is due to significant ratio differences: (a) with respect to Remember subcategory, the topics 2a, 3a, 3b, 4a, 4b, and 4d are critically misaligned (ratio difference ranges from 0.021 to 0.026), (b) with respect to Understand subcategory, the topic 4b is critically misaligned (ratio difference is 0.0.015), (c) with respect to skills subcategory, the topics 1a, 1b, and 4b are significantly misaligned (ratio differences ranges from 0.012 to 0.0.14), and (d) with respect to STS Connection subcategory, the topics 1a, 1b, 2a, 3a, 3b, 4a, 4b, 4d, 5a, 7a, and 7b are critically misaligned (ratio difference ranges from 0.006 to 0.014).

Table 4.54

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Z2)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.021	0.016	0.003	0.008	0.048
1b	0.011	0.007	0.012	0.008	0.039
2a	0.029	0.006	0.031	0.009	**0.075**
3a	0.023	0.006	0.007	0.010	0.045
3b	0.025	0.005	0.012	0.007	0.049
4a	0.027	0.012	0.004	0.011	**0.054**
4b	0.031	0.018	0.019	0.005	0.073
4c	0.019	0.000	0.017	0.002	0.038
4d	0.026	0.005	0.009	0.012	**0.051**
5a	0.000	0.002	0.009	0.011	0.022
5b	0.012	0.013	0.004	0.005	0.034
6a	0.004	0.004	0.008	0.009	0.025
6b	0.020	0.014	0.014	0.008	**0.056**
7a	0.010	0.006	0.010	0.006	0.031
7b	0.014	0.012	0.006	0.004	0.036
8a	0.018	0.011	0.002	0.004	0.035
8b	0.004	0.001	0.006	0.003	0.014
9a	0.023	0.011	0.015	0.003	**0.052**
9b	0.008	0.000	0.002	0.006	0.017
Total	**0.323**	**0.150**	**0.191**	**0.131**	**0.795**
		Alignment Index			**0.60**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.54 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z2 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z2 to Grade IX

students at fine grain level is 0.60 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 2a, 4a, 4b, and 6b (sum of ratio difference ranges from 0.054 are 0.073) and STS connection subcategory of cognitive demand (sum of ratio difference is 0.131) are misaligned to the critical level. The topics 1a, 3a, 3b, 4d, and 9a (sum of ratio difference ranges from 0.045 to 0.053) and Remember subcategory of cognitive demand (sum of ratio difference is 0.323) are misaligned to the significant level. Understand and Skills subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.150 and 0.191 respectively)

The misalignment between the written curriculum and curriculum taught by Group Z2 to Grade IX students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 2a, 3a, 3b, 4a, 4b, 4d, and 9a (ratio difference ranges from 0.023 to 0.031), (b) with respect to Understand subcategory for the topics 1a, 4b, and 6b (ratio differences ranges from 0.014 to 0.018), (c) with respect to skills subcategory for the topics 2a, 4b, 4c, and 9a (ratio differences ranges from 0.015 to 0.0.31), and (d) with respect to STS Connection subcategory for the topics 1a, 1b, 2a, 3a, 3b, 4a, 4d, 5a, 6a, 6b, 7a, and 9b (ratio difference ranges from 0.006 to 0.012).

Table 4.55

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Z3)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.020	0.018	0.007	0.009	**0.053**
1b	0.016	0.006	0.017	0.007	0.046
2a	0.032	0.007	0.031	0.006	**0.076**
3a	0.023	0.007	0.006	0.011	0.046
3b	0.027	0.008	0.012	0.007	**0.055**
4a	0.029	0.010	0.007	0.013	**0.059**
4b	0.033	0.019	0.020	0.007	**0.079**
4c	0.017	0.002	0.017	0.003	0.038
4d	0.031	0.008	0.011	0.012	**0.063**
5a	0.006	0.005	0.010	0.009	0.029
5b	0.025	0.017	0.005	0.003	**0.050**
6a	0.008	0.005	0.009	0.006	0.028
6b	0.024	0.016	0.015	0.007	**0.062**
7a	0.011	0.005	0.013	0.007	0.036
7b	0.020	0.014	0.007	0.002	0.044
8a	0.020	0.013	0.002	0.005	0.039
8b	0.026	0.007	0.014	0.006	**0.053**
9a	0.025	0.014	0.016	0.005	**0.059**
9b	0.011	0.000	0.006	0.005	0.023
Total	**0.406**	**0.182**	**0.223**	**0.128**	**0.939**
		Alignment Index			**0.53**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.55 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z3 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z3 to Grade IX

students at fine grain level is 0.53 which reflects a significant misalignment level. The topics 2a, 3b, 4a, 4b, 4d, 6b, and 9a (sum of ratio difference ranges from 0.055 are 0.079) as well as Remember and STS connection subcategories of cognitive demand (sums of ratio difference are 0.406 and 0.128 respectively) are misaligned to the critical level. The topics 1a, 1b, 3a, 5b, 7b and 8b (sum of ratio difference ranges from 0.044 to 0.055) and Skills category of cognitive demand (sum of ratio difference is 0.223) are misaligned to the significant level. Understand subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.182)

The misalignment between the written curriculum and curriculum taught by Group Z3 to Grade IX students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, 8b, and 9a (ratio difference ranges from 0.023 to 0.033), (b) with respect to Understand subcategory for the topics 1a, 4b, 5b, 6b, 7b, and 9a (ratio differences ranges from 0.014 to 0.0.19), (c) with respect to skills subcategory for the topics 2a, 4b, 4c, 6b, and 9a (ratio differences ranges from 0.015 to 0.0.31), and (d) with respect to STS Connection subcategory for the topics 1a, 1b, 2a, 3a, 3b, 4a,4b, 4d, 5a, 6a, 6b, 7a, and 8b (ratio difference ranges from 0.006 to 0.013).

Table 4.56

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade IX, Group Z4)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
1a	0.013	0.012	0.000	0.001	0.026
1b	0.012	0.003	0.010	0.000	0.025
2a	0.016	0.004	0.022	0.002	0.043
3a	0.010	0.004	0.003	0.011	0.028
3b	0.013	0.001	0.007	0.005	0.026
4a	0.013	0.001	0.001	0.015	0.029
4b	0.024	0.012	0.015	0.003	**0.054**
4c	0.007	0.002	0.010	0.002	0.019
4d	0.014	0.003	0.008	0.009	0.034
5a	0.004	0.000	0.005	0.001	0.010
5b	0.009	0.006	0.002	0.001	0.018
6a	0.007	0.003	0.005	0.002	0.018
6b	0.023	0.014	0.013	0.004	**0.054**
7a	0.003	0.002	0.005	0.005	0.016
7b	0.010	0.009	0.006	0.004	0.029
8a	0.013	0.007	0.002	0.004	0.027
8b	0.006	0.005	0.002	0.002	0.015
9a	0.014	0.010	0.011	0.007	0.043
9b	0.003	0.007	0.003	0.001	0.014
Total	**0.214**	**0.105**	**0.131**	**0.078**	**0.528**
		Alignment Index			**0.74**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.56 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z4 to Grade IX students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z4 to Grade IX

students at fine grain level is 0.74 which reflects a considerable alignment level. However, degree of alignment is different for different topics and subcategories (sum of ratio differences ranges from 0.010 to 0.54). The topics 4b and 6b are comparatively less aligned (sum of ratio difference 0.054). On the other hand, topics 5a, 8b, and 9b are comparatively more aligned (sum of ratio difference ranges from 0.010 to 0.015). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and Skills are comparatively more misaligned (sum of ratio differences are 0.214 and 0.131 respectively) than the other subcategories.

Table 4.57

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Z1)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.024	0.002	0.020	0.002	**0.048**
10b	0.013	0.006	0.001	0.020	0.041
11a	0.000	0.013	0.004	0.009	0.026
11b	0.008	0.004	0.002	0.003	0.016
12a	0.013	0.007	0.003	0.003	0.025
12b	0.019	0.008	0.002	0.009	0.038
12c	0.023	0.008	0.001	0.015	**0.046**
13a	0.008	0.003	0.003	0.002	0.015
13b	0.007	0.001	0.002	0.004	0.015
13c	0.023	0.018	0.004	0.010	**0.055**
14a	0.016	0.005	0.001	0.010	0.031
14b	0.007	0.003	0.008	0.004	0.023
14c	0.015	0.006	0.002	0.007	0.029
15a	0.016	0.003	0.001	0.012	0.032
15b	0.018	0.004	0.008	0.006	0.036
16a	0.011	0.007	0.002	0.002	0.023
16b	0.023	0.011	0.001	0.010	**0.046**
17a	0.006	0.010	0.002	0.007	0.026
17b	0.004	0.006	0.010	0.013	0.032
18a	0.010	0.002	0.006	0.006	0.023
18b	0.022	0.016	0.006	0.013	**0.057**
Total	**0.285**	**0.144**	**0.089**	**0.166**	**0.684**
		Alignment Index			**0.66**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.57 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z1 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z1 to Grade X students at fine grain level is 0.66 which reflects a considerable misalignment level. However, degree of misalignment is different for different topics (sum of ratio difference ranges from 0.015 to 0.057) and subcategories (sum of ratio difference ranges from 0.089 to 0.285). The topics 13c and 18b (sum of ratio difference are 0.055 to 0.057 respectively) are misaligned to the critical level. Similarly, topics 10a, 10b, 12c, and 16b (sum of ratio difference ranges from 0.041 to 0.048) as well as STS connection (sum of ratio difference is 0.166) subcategories of cognitive demand are significantly misaligned. While Remember and Understand subcategories of cognitive demand are considerably misaligned (sums of ratio difference are 0.285 and 0.144 respectively).

The misalignment between the written curriculum and curriculum taught by Group Z1 to Grade X students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 10a, 12b, 12c, 13c, 16b, and 18b (ratio difference ranges from 0.019 to 0.024), (b) with respect to Understand subcategory for the topics 11a, 16b, and 18b (ratio difference ranges from 0.011 to 0.016), (c) with respect to skills subcategory for the topic 10a (ratio difference is 0.020), and (d) with respect to STS Connection subcategory, the topics 10b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.020).

Table 4.58

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Z2)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.021	0.002	0.018	0.002	0.043
10b	0.018	0.011	0.005	0.024	**0.058**
11a	0.013	0.012	0.002	0.001	0.029
11b	0.015	0.002	0.008	0.005	0.031
12a	0.022	0.007	0.009	0.006	0.044
12b	0.024	0.008	0.008	0.009	0.049
12c	0.021	0.007	0.002	0.015	0.045
13a	0.013	0.003	0.007	0.004	0.027
13b	0.009	0.002	0.003	0.004	0.018
13c	0.019	0.019	0.010	0.010	**0.057**
14a	0.020	0.009	0.002	0.010	0.041
14b	0.016	0.001	0.016	0.001	0.035
14c	0.020	0.009	0.004	0.007	0.041
15a	0.021	0.004	0.000	0.017	0.042
15b	0.023	0.009	0.008	0.007	0.047
16a	0.012	0.008	0.002	0.002	0.024
16b	0.030	0.012	0.005	0.012	**0.059**
17a	0.010	0.009	0.006	0.004	0.030
17b	0.007	0.010	0.010	0.014	0.041
18a	0.011	0.007	0.006	0.003	0.026
18b	0.022	0.019	0.010	0.013	**0.064**
Total	**0.367**	**0.171**	**0.141**	**0.170**	**0.848**
		Alignment Index			**0.58**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.58 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z2 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z2 to Grade X students at fine grain level is 0.58 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10b, 12b, 13c, 16b and 18b (sum of ratio difference ranges from 0.049 to 0.064) are misaligned to the critical level. Similarly, topics 10a, 12a, 12c, 14a, 14c, 15a, 15b, and 17b (sum of ratio difference ranges from 0.041 to 0.047) as well as Remember (sum of ratio difference is 0.367), Understand (sum of ratio difference is 0.171), and STS connection (sum of ratio difference is 0.170) subcategories of cognitive demand are significantly misaligned. While Skills subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.141).

The misalignment between the written curriculum and curriculum taught by Group Z2 to Grade X students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 10a, 12a, 12b, 12c, 14a, 14c, 15a, 15b, 16b, and 18b (ratio difference ranges from 0.020 to 0.030), (b) with respect to Understand subcategory for the topics 10b, 11a, 13c, 16b, and 18b are critically misaligned (ratio difference ranges from 0.011 to 0.019), (c) with respect to skills subcategory for the topics 10a and 14b (ratio differences are 0.016 and 0.018), and (d) with respect to STS Connection subcategory for the topics 10b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.010 to 0.024).

Table 4.59

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Z3)

Topic Number	Ratio Difference with respect to				
	Remember13	Understand13	Skills13	STS13	Total
10a	0.030	0.004	0.024	0.002	**0.060**
10b	0.028	0.003	0.007	0.024	**0.062**
11a	0.014	0.014	0.003	0.002	0.032
11b	0.017	0.004	0.009	0.004	0.034
12a	0.023	0.008	0.010	0.004	0.046
12b	0.028	0.010	0.009	0.009	**0.055**
12c	0.027	0.009	0.002	0.015	**0.054**
13a	0.016	0.003	0.009	0.004	0.032
13b	0.013	0.003	0.006	0.004	0.026
13c	0.036	0.024	0.000	0.012	**0.071**
14a	0.032	0.012	0.008	0.012	**0.063**
14b	0.015	0.003	0.021	0.008	0.047
14c	0.028	0.013	0.007	0.009	**0.057**
15a	0.025	0.007	0.000	0.018	**0.051**
15b	0.024	0.009	0.008	0.007	**0.049**
16a	0.016	0.011	0.003	0.002	0.031
16b	0.031	0.014	0.006	0.011	**0.062**
17a	0.016	0.010	0.006	0.000	0.032
17b	0.004	0.003	0.009	0.016	0.032
18a	0.000	0.003	0.005	0.003	0.010
18b	0.027	0.023	0.012	0.016	**0.077**
Total	**0.451**	**0.191**	**0.162**	**0.183**	**0.986**
		Alignment Index			**0.51**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.59 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z3 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z3 to Grade X students at fine grain level is 0.51 which reflects a significant misalignment level. However, degree of misalignment is different for different topics and subcategories. The topics 10a, 10b, 12b, 12c, 13c, 14a, 14c, 15a, 15b, 16b and 18b (sum of ratio difference ranges from 0.049 to 0.077) as well as Remember (sum of ratio difference is 0.451) category of cognitive demand are misaligned to the critical level. Similarly, topics 12a and 14b (sum of ratio difference ranges from 0.040 to 0.047) as well as Understand (sum of ratio difference is 0.191) and STS connection (sum of ratio difference is 0.183) subcategories of cognitive demand are significantly misaligned. While Skills subcategory of cognitive demand is considerably misaligned (sum of ratio difference is 0.162).

The misalignment between the written curriculum and curriculum taught by Group Z3 to Grade X students is due to significant ratio differences: (a) with respect to Remember subcategory for the topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15a, 15b, 16b, and 18b (ratio difference ranges from 0.020 to 0.031), (b) with respect to Understand subcategory for the topics 11a, 13c, 16a, 16b, and 18b (ratio difference ranges from 0.011 to 0.020), (c) with respect to skills subcategory for the topics 10a and 14b (ratio differences are 0.024 and 0.016 respectively), and (d) with respect to STS Connection subcategory for the topics 10b, 12c, 15a, 16b, 17b, and 18b (ratio difference ranges from 0.011 to 0.024).

Table 4.60

Fine Grain level Alignment analysis of Written and Taught Curricula (Grade X, Group Z4)

Topic Number	Ratio Difference with respect to				
	Remember13	**Understand13**	**Skills13**	**STS13**	**Total**
10a	0.015	0.004	0.017	0.002	**0.039**
10b	0.008	0.004	0.003	0.014	0.028
11a	0.005	0.010	0.003	0.008	0.026
11b	0.010	0.002	0.006	0.003	0.021
12a	0.010	0.005	0.004	0.002	0.021
12b	0.016	0.004	0.003	0.008	0.031
12c	0.013	0.007	0.003	0.009	0.032
13a	0.005	0.002	0.005	0.002	0.015
13b	0.009	0.001	0.004	0.003	0.018
13c	0.012	0.010	0.006	0.009	**0.037**
14a	0.010	0.002	0.000	0.008	0.020
14b	0.002	0.004	0.009	0.003	0.019
14c	0.010	0.004	0.001	0.004	0.020
15a	0.007	0.002	0.005	0.010	0.025
15b	0.013	0.008	0.007	0.001	0.028
16a	0.009	0.006	0.002	0.001	0.018
16b	0.016	0.008	0.004	0.005	0.032
17a	0.004	0.004	0.004	0.004	0.016
17b	0.002	0.010	0.000	0.007	0.019
18a	0.001	0.003	0.000	0.002	0.005
18b	0.023	0.011	0.000	0.013	**0.047**
Total	**0.201**	**0.110**	**0.086**	**0.118**	**0.516**
		Alignment Index			**0.74**

Note: 13=between Written and Taught Curricula, STS=STS Connection

Table 4.60 shows fine grain level alignment analysis of written curriculum and the curriculum taught by Group Z4 to Grade X students. It shows that the alignment index between written curriculum and the curriculum taught by Group Z4 to Grade X students at fine grain level is 0.74 which reflects a considerable alignment level. However, degree of alignment is different for different topics (sum of ratio difference ranges from 0.005 to 0.047) and subcategories (sum of ratio difference ranges from 0.086 to 0.201). The topics 10a, 13c, and 18b are comparatively less aligned (sum of ratio difference ranges from 0.037 to 0.047). On the other hand, topics 13a, 17a, and 18a are comparatively more aligned (sum of ratio difference ranges from 0.005 to 0.016). As for as the sub categories of cognitive demand are concerned, the subcategories Remember and STS Connection are comparatively more misaligned (sum of ratio differences are 0.201 and 0.118 respectively) than the other subcategories.

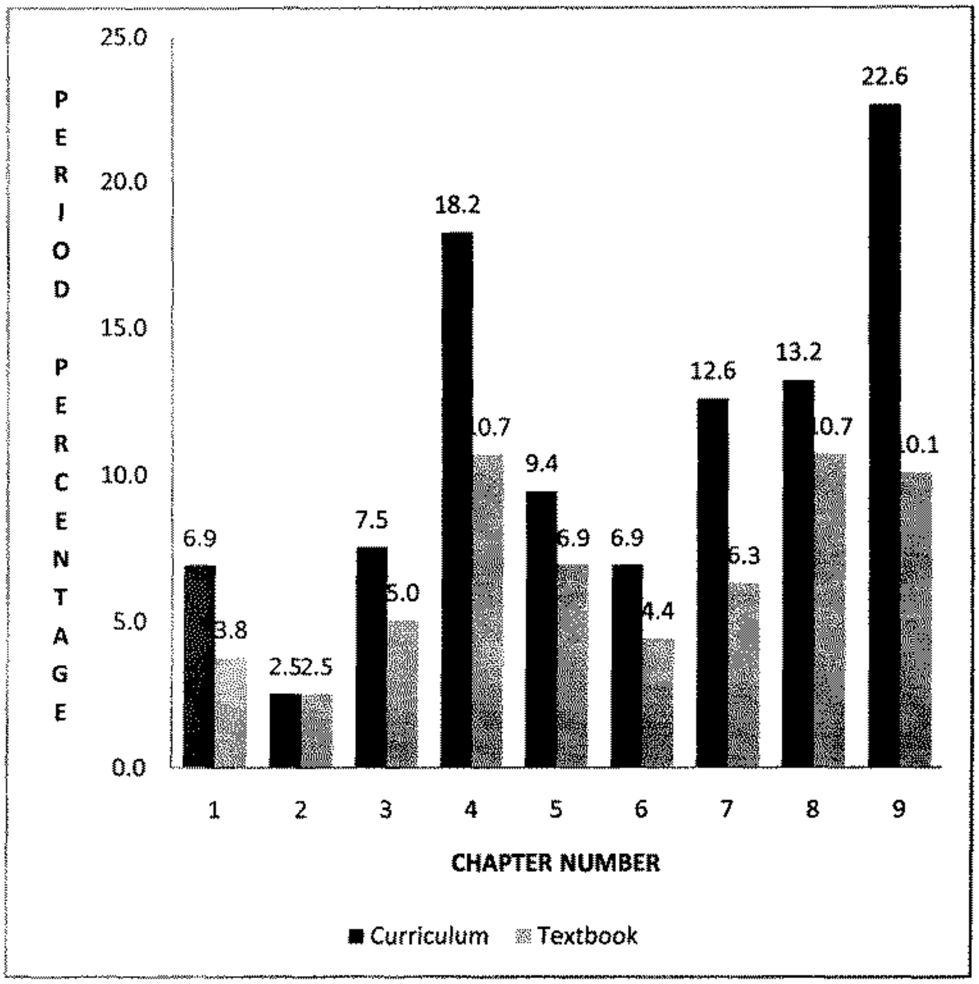

Figure 4.57. Chapter wise Class Period Comparison between the written curriculum and textbook Grade IX

Figure 4.57 shows the chapter wise class period comparison between the written curriculum and textbook Grade IX. It shows that except chapter 2, there is complete inconsistency between the written curriculum and the textbook Grade IX with respect to class period. Maximum gap is in chapter 9 where difference of percentage reaches 12.5%. Moreover, the percentage of class periods given in the textbook is less than that of written curriculum. The reason of less percentage of class periods may be that the content given in textbook mainly focuses on SLO of lower level.

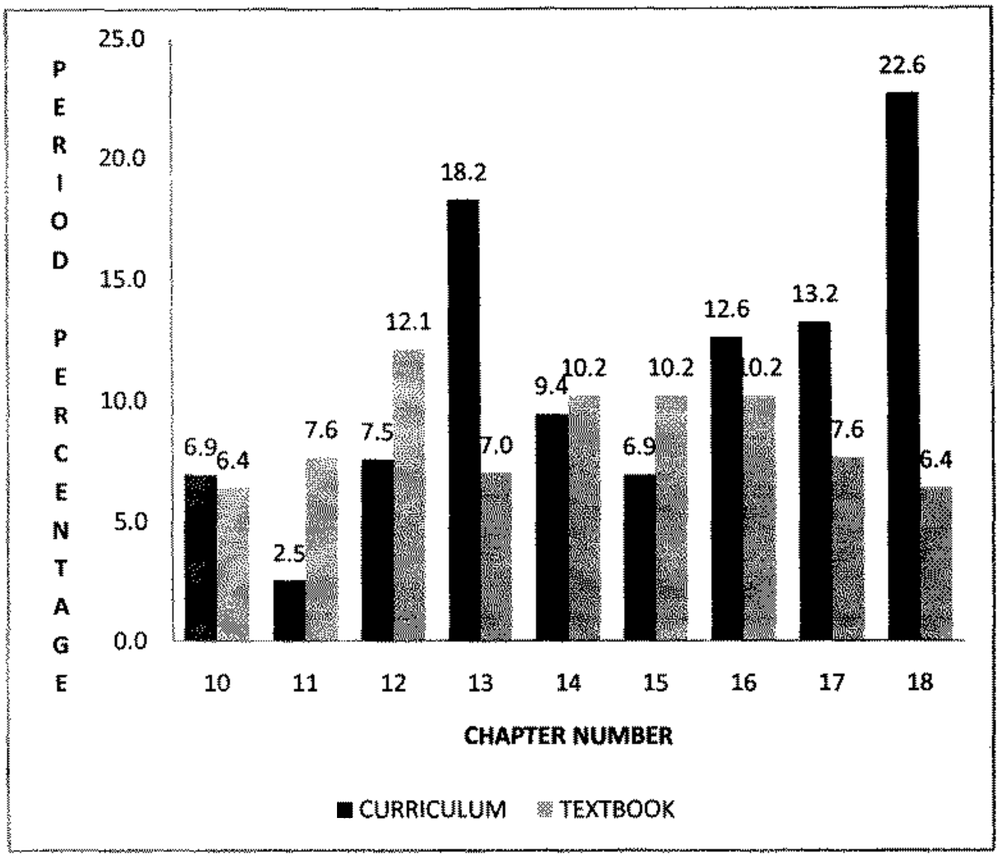

Figure 4.58. Chapter wise Class Period Comparison between the written curriculum and textbook Grade X

Figure 4.58 shows the chapter wise class period comparison between the written curriculum and textbook Grade X. There is not a single chapter in which the written curriculum and the textbook Grade X are completely aligned with respect to class period. Maximum gap is in chapter 18 where difference of percentage reaches 18.2%.

Moreover, the percentage of class periods given in the textbook is less than that of written curriculum. The reason of less percentage of class periods may be that the content given in textbook mainly focuses on SLO of lower level.

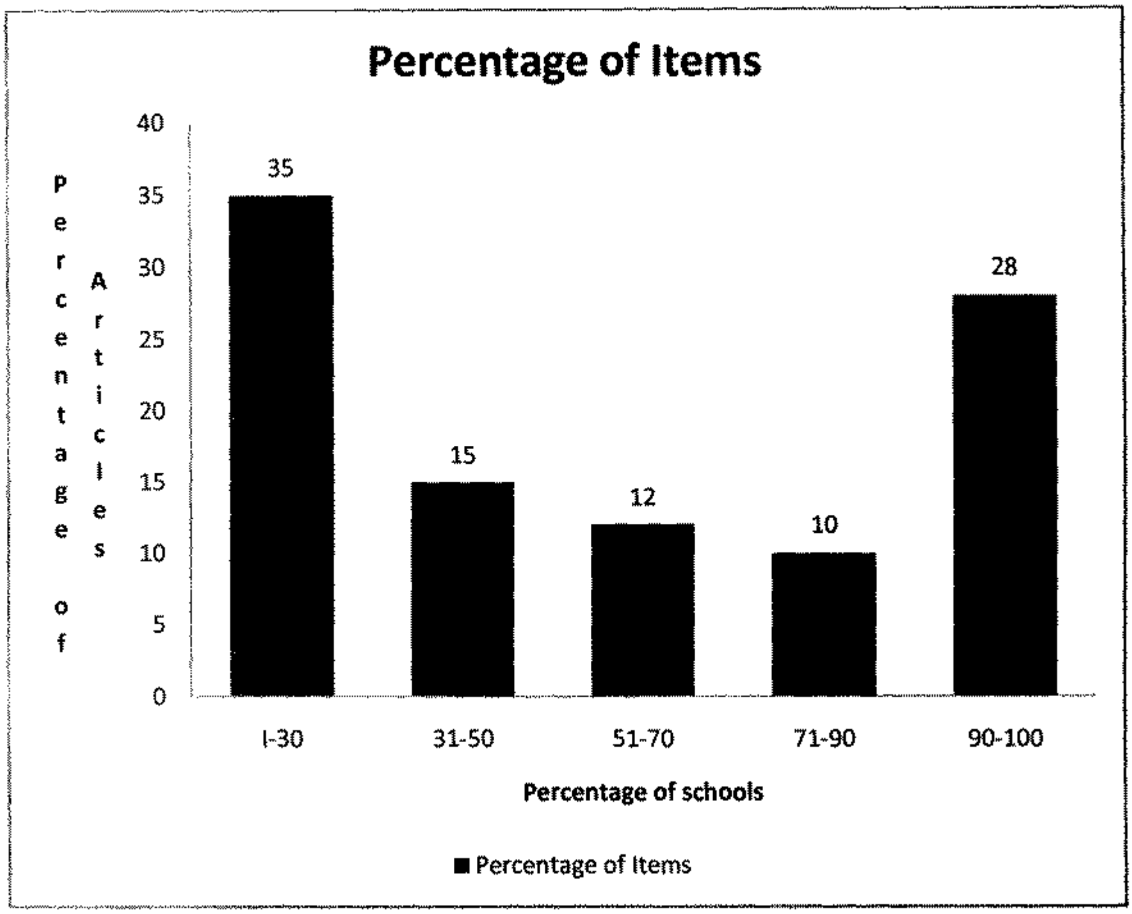

Figure 4.59. Availability of Supporting Materials in Schools

Figure 4.59 shows availability of supporting materials in schools. It shows that only 28% articles are available in 90% to 100% schools. The percentage of schools having 50% of the materials proposed in the written curriculum is only 50%. A sufficient percentage (30%) of schools has only 30% of the materials mentioned in the written curriculum.

Discussion

The study aimed at finding the alignment level of supported, taught, and assessed curricula with the written curriculum. The alignment level was quantitatively measured at two levels viz. coarse grain level (taking six sections of content into consideration) and fine grain level (taking 40 topics into consideration). The alignment level was measured by using SEC model of measurement of curriculum alignment.

It was found that the textbooks were considerably aligned with the written curriculum at coarse grain level. However, some sections individually were misaligned, which was due to overemphasis on Remember subcategory and neglecting the STS connection. At fine grain level, textbook-Grade IX was considerably aligned while textbook-Grade X was considerably misaligned with the written curriculum. However, individually many topics in the textbooks for Grades IX & X were misaligned. This misalignment ranged from considerable level to critical level. It was because the textbook provided extra content about Remember subcategory of the cognitive demand. There was less content with respect to Understand subcategory and STS Connection was neglected completely. Moreover, the schools were deficient in materials mentioned in the written curriculum. These findings partially agree with those of Akhtar (2004), Rehman (2004) and Faize (2011) who found that the content in the textbooks were overloaded and was not helpful in achieving the desired objectives.

On the whole, the alignment level between written curriculum and the question papers at coarse grain level varied from considerably misaligned (question papers by BISE (L)) to considerably aligned (question papers by BISE (M) and BISE (N)). However, at fine grain level, there was significant misalignment between written curriculum and the question papers for Grade IX and Grade X administered by all BISEs. Most of the topics were misaligned. Moreover, the question papers for Grade IX and Grade X administered by all the BISEs overemphasised Remember subcategory. This overemphasis resulted in complete ignoring the STS Connection subcategory and reduced emphasis on other subcategories, particularly Understand. Kanwal (2001) also found imbalance in distribution of items relating to categories of objectives in the textbook and the examination papers in the subject of English. These findings are also endorsed by studies conducted by Shah and Tariq (1986-87), Rehman (2004), Naeem Ullah (2007), and Faize (2011) when they found that examinations encouraged rote-memorization and lacked proper representation of content.

The written curriculum and curriculum taught by the Teachers of cluster 4 were aligned both at coarse grain level and fine grain level. However, the alignment level between written curriculum and curriculum taught by all other teachers (Clusters 1, 2, and 3) was considerably misaligned at coarse grain level and significantly misaligned at fine grain level. This alignment gap varied across topics and categories of cognitive demand. Mostly, the misalignment was due to greater ratio difference of sections/topics with respect to STS connection and Remember subcategories of cognitive demand.

From the results of alignment level between written and taught curricula, two important inferences may be drawn. Firstly, professional qualification may be factor for enhancing alignment of taught curriculum with the written curriculum. It is because the instruction of teachers with master level professional qualification (Cluster 4) was more aligned with the written curriculum. So, this group of teachers belong to "level 1" of McNeil's (2006, p. 228) categorization of teachers with respect to curriculum. Secondly, most of the teachers (particularly those whose instruction is not aligned with written curriculum) as well as the examiners might have used only the textbooks as instructional or assessment manuals. The reason behind this inference is the misalignment trend that we find in the textbook does exist in taught curriculum as well as in question papers. For example, the gap between the textbooks and written curriculum was more with respect to Remember subcategory of cognitive domain, this was also found in the taught curriculum and question papers. Moreover, textbooks lacked content with respect to STS connection. The question papers also had not items relating to STS connection and the same trend was also found in taught curriculum.

The alignment level between the written curriculum and the question papers is comparatively better at coarse grain level than at fine grain level. It indicates that there is proper distribution of items at section level. However, this distribution of items does not match the written curriculum at topic level. The number of SLO differs for every topic proposed in the written curriculum. Moreover, there is also difference of emphasis on every topic with reference to cognitive complexity. The alignment level can be increased if items for question papers from topics are selected in proportion of number and nature of SLO proposed in written curriculum.

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The study was conducted to determine the alignment level of taught, supported, and assessed curricula with the written curriculum. This chapter presents summary, findings, conclusions, discussion, and recommendations of study on the basis of data collected from (a) 400 schools, (b) 436 teachers, (c) six Biology IX & X question papers administered by three BISEs (d) two Textbooks of Biology-IX & Biology-X, and (f) National Curriculum for Biology (Grades IX-X).

5.1. Summary

The study aimed at finding the alignment of taught, supported and assessed curricula with the written curriculum. Chapter one was an introductory chapter and provided the glimpse of the study. This chapter explained the nature of the research problem and the relevance and need of the study. After describing (a) the research problem, (b) objectives of study, (c) research questions, and (d) conceptual framework, this chapter also highlighted the research design of study.

Chapter two provided theoretical foundations and background knowledge of study through review of the literature that related to the study. Major discussions of this chapter were (a) definitions of curriculum, (b) curriculum alignment models, (c) alignment measurement models, and (d) an overview of secondary education in the

Punjab. This chapter also discussed how the present study built on the previous studies conducted on curriculum and took these studies forward.

Chapter three discussed the methodology employed in this research; including its design, procedure and instruments. This chapter also explained development of research instruments as well as application of the research instruments for data collection. It also explained the measures taken to ensure the validity and reliability of instruments. This chapter also explained how the data were collected and analysed.

Chapter four presented the analysis of data collected through research instruments; (a) observation check list, (b) survey of enacted curriculum protocol for teachers, and (c) content analysis protocol for textbooks and question papers. The data was presented in the form of tables and graphs. Following the SEC alignment measurement model, the extent of alignment was measured quantitatively by developing matrices of same order, and applying the mathematical procedure of using cell by cell comparison of data of the two sets. The alignment index was found by applying alignment index formula (Porter, 2002) used in SEC alignment measurement model.

Curriculum audit report consists of following sections:

1. Introduction
2. Methodology
3. Findings
4. Recommendations
5. Summary (Phi Delta Kappa International, 2013)

The first two sections have been described in earlier chapters while the rest of sections i.e. findings, recommendations, and summary have been presented in this chapter (chapter 5).

5.2. Findings

Findings are given in detail under three headings in conformity with the three objectives and research questions of study.

5.2.1 Alignment of Supported Curriculum with Written Curriculum

1. There was considerable alignment (AI was 0.72) between written curriculum and textbooks at coarse grain level. However, the sections A, E, and F were considerably misaligned (sums of RD were 0.125, 0.127, and 0.552 respectively). Similarly, on the whole subcategory STS Connection was critically misaligned (sum of RD was 0.158) and subcategory Remember was considerably misaligned (sum of RD was 0.256). Moreover, all the sections (except section B) were critically misaligned with respect to STS connection subcategory. Furthermore, sections E and F were considerably misaligned with respect to subcategories Understand (RDs were 0.029 and 0.024) and Remember (RDs were 0.056 and 0.052). (Table 4.1)

2. At coarse grain level, content with respect to SLO of Remember subcategory of cognitive demand in the textbooks were much higher (e.g. in sections A, E, and F, the difference ranged from 31% to 38%) than that of written curriculum. Conversely, SLO percentages of most of the sections in the textbooks were less (difference was up to 15%) than that of written curriculum with respect to Understand and Skills subcategories of cognitive demand. Moreover, in contrast to written curriculum's requirement, the textbooks did not provide any content with respect to STS Connection. (Figures 4.1- 4.4)

3. There was considerable alignment (AI was 0.74) between written curriculum and textbook –Grade IX at fine grain level. However, subcategory STS connection (sum of RD was 0.091) and topic 2a (sum of RD was 0.073) were misaligned to the critical level. Similarly, topics 3a and 4a (sum of RD ranged from 0.043 to 0.049) were significantly misaligned, while the topics 1a, 4b, 4c, 4d, and 6b (RD ranged from 0.033 to 0.042) were considerably misaligned. Individually, with respect to Remember subcategory, the topics 2a and 4a were critically misaligned (RDs were 0.025 and 0.035), and topics 1a, 3a, 4c and 6b were significantly misaligned (RD ranged from 0.018 to 0.021). Similarly, topics 4b, 6b, and 9a (RD range was from 0.014 to 0.021with respect to Understand) and topics 3a, 4a and 4d (RD ranged from 0.013 to 0.016 with respect to STS Connection) were critically misaligned. (Table 4.2)

4. At fine grain level, content for SLO of all topics (except topic 7b) with respect to Remember subcategory of cognitive demand in textbook-Grade IX were much higher (difference ranged from 5% to 67%) than that of written curriculum. Conversely, content for most of the sections in textbook-Grade IX were less than that of written curriculum with respect to Understand (difference was up to 40%) and Skills (difference was up to 67%) subcategories of cognitive demand. Moreover, in contrast to written curriculum's requirement, textbook-Grade IX did not provide any content with respect to STS Connection. (Figures 4.5- 4.8)

5. There was considerable misalignment (AI was 0.68) between written curriculum and textbook –Grade X at fine grain level. Subcategory STS connection (sum of RD was 0.197) and topics 10b, 14b, and 18b (sum of RD ranged from 0.056 to 0.074) were misaligned to the critical level. Similarly, topics 13c, 14c, 15a, and 16b (sum of RDs ranged from 0.040 to 0.048) were significantly misaligned, while the topics 12c and 17b (RD ranged from 0.032 to 0.035) were considerably misaligned. Individually, with respect to Remember subcategory, the topics 10b, 13c, 14c, 15a, 16b, and 18b were critically misaligned (RD ranged from 0.020 to 0.037) and topics 14a and 17b were significantly misaligned (RD was 0.016). Similarly, topics 14a, 14c, 17a, and 18b (RD ranged from 0.012 to 0.025 with respect to Understand) and topics 10b, 12b, 12c, 13c, 14a, 15a, 16c, 17b, and 18b (RD ranged from 0.012 to 0.026 with respect to STS Connection) were critically misaligned. (Table 4.3)

6. At fine grain level, all the topics in textbook-Grade X and written curriculum were completely misaligned with respect to Remember (percentage difference of content for SLO ranged from 7% to 88%), Understand (percentage difference of content for SLO ranged from 1% to 53%) and STS Connection (no content relating to this subcategory in textbook) subcategories of cognitive demand. Moreover, percentage differences of content for SLO of textbook-Grade X were higher with respect to Remember subcategory and fewer with respect to other subcategories. However, there was comparatively more alignment between the textbook-Grade X and the written curriculum with respect to Skills subcategory of cognitive demand. (Figures 4.9- 4.12)

7. Except chapter 2, there was complete inconsistency between the written curriculum and the textbook Grade IX with respect to class period. Maximum gap was in chapter 9 where difference of percentage reached 12.5%. No chapter in textbook Grade X was completely aligned with the written curriculum with respect to class period. Maximum gap was in chapter 18 where difference of percentage reaches 18.2%. (Figure 4.57-4.58)

8. The schools were deficient in materials mentioned in the written curriculum. Only 28% articles were available in 90% to 100% schools. The percentage of schools having 50% materials was only 50%. A sufficient percentage (30%) of schools had only 30% of the materials mentioned in the written curriculum. (Figure 4.59)

5.2.2. Alignment of Question Papers by BISEs with Written Curriculum

1. There was considerable misalignment (AI was 0.68) between written curriculum and question papers by BISE (L) at coarse grain level. The subcategory STS connection (sum of RD was 0.158) and section E (sum of RD was 0.185) were misaligned to the critical level. Similarly, subcategory Remember (sum of RD 0.297) was considerably misaligned. Moreover, the section E was critically misaligned (RD was 0.093) and the sections B and C were considerably misaligned (RD was 0.049) with respect to Remember subcategory. Similarly, the section E was considerably misaligned (RD was 0.029) with respect to Understand subcategory. All sections (except section B) were critically misaligned (RD ranged from 0.024 to 0.034) with respect to STS Connection subcategory. (Table 4.4)

2. At coarse grain level, there was considerable level of alignment (AI was 0.71) between written curriculum and question papers by BISE (M). However, the subcategory STS Connection (sum of RD was 0.158) and section E (sum of RD was 0.169) were misaligned to the critical level. Similarly, section B (sum of RD was 0.118) and subcategory Remember (sum of RD was 0.244) were considerably misaligned. Moreover, the section E was critically misaligned (RD was 0.084) and the section B was significantly misaligned (RD was 0.059) with respect to Remember subcategory. The sections B and E were considerably misaligned (RD ranged from 0.027 to 0.029) with respect to Skills subcategory. Similarly, all sections (except

section B) were critically misaligned (RD ranged from 0.029 to 0.034) with respect to STS Connection subcategory. (Table 4.5)

3. At coarse grain level, there was considerable level of alignment (AI was 0.74) between written curriculum and question papers by BISE (N). However, subcategory STS connection (sum of RD was 0.158) was misaligned to the critical level. Similarly, section A (sum of RD 0.109) was considerably misaligned. Moreover, the sections A, C, E, and F were significantly misaligned (RD ranged from 0.042 to 0.055) with respect to Remember subcategory, and (b) with respect to STS Connection subcategory, all sections (except section B) were critically misaligned (RD ranged from 0.024 to 0.034). (Table 4.6)

4. At coarse grain level, all the sections in question papers from all BISEs and written curriculum were misaligned with respect to Remember (percentage difference of content for SLO ranged from 5% to 56%), Understand (percentage difference of content for SLO ranged from 4% to 20%), Skills (Percentage difference of content for SLO ranged from 1%, to 21%), and STS Connection (Percentage difference of content for SLO ranged from 6%, to 21%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers from all BISEs were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from none of the BISEs consisted of any item with respect to STS connection subcategory. (Figures 4.13- 4.16)

5. At fine grain level, there was significant misalignment (AI was 0.52) between written curriculum and question papers (Grade IX) by BISE (L). The topics 3a, 4a, 4b, 4c, 4d, 5b, 8a, 8b, and 9a (sum of RD ranged from 0.055 to 0.074) and subcategory STS connection (sum of RD was 0.091) were misaligned to the critical level. Similarly, topics 3b, 6b, and 9a (sum of RD ranged from 0.043 to 0.053) and

subcategories Remember, Understand, and Skills (sum of RD ranged from 0.238 to 0.389) were significantly misaligned, while topics 2a, 4a, and 7b (RD ranged from 0.035 to 0.041) were considerably misaligned. Moreover, individually topics 3a, 4b, 4d, 5a, 5b, 8a, 8b, 9a, and 9b (RD ranged from 0.022 to 0.044 with respect to Remember), topics 4a, 4c, 6b, 7b, 8a, and 9a (RD ranged from 0.015 to 0.031 with respect to Understand), topic 4a (RD was 0.016 with respect to STS Connection) were critically misaligned. (Table 4.7)

6. At fine grain level, all the topics in question papers (Grade-IX) from BISE (L) and written curriculum were misaligned with respect to Remember (percentage difference of content for SLO ranged from 5% to 73%), Understand (percentage difference of content for SLO ranged from 5% to 66%), Skills (Percentage difference of content for SLO ranged from 2%, to 75%), and STS Connection (Percentage difference of content for SLO ranged from 8%, to 30%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers from BISE (L) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (L) had no item with respect to STS connection subcategory. (Figures 4.17- 4.20)

7. At fine grain level, there was significant misalignment (AI was 0.50) between written curriculum and question papers (Grade X) by BISE (L). The topics 10b, 11b, 12a, 12b, 12c, 13c, 14b, 15a, and 16b (sum of RD ranged from 0.052 to 0.071) and subcategories Remember and STS connection (sum of RD were 0.410 and 0.191) were misaligned to the critical level. Similarly, topics 11a, 14c, 15b, 17a, and 18b (sum of RD ranged from 0.041 to 0.048) and subcategories Understand, and Skills (sum of RD ranged from 0.191 to 0.206) were significantly misaligned, while the topics 10a, 13a, 13b, 14a, 16a, and 17b (RD ranged from 0.032 to 0.038) were

considerably misaligned. Moreover, individually topics 11b, 12a, 12b, 12c, 13c, 14b, 14c, 15a, 16b, 17a, and 18b (RD ranged from 0.021 to 0.036 with respect to Remember), topics 10b, 12a, 12b, 12c, 13b, 13c, 14c, 16b, and 17a (RD ranged from 0.011 to 0.014 with respect to Understand), topics 10a, 11a, 11b, 12a, 12b, 13a, 13b, 14a, 14b and 15b (RD ranged from 0.011 to 0.024 with respect to Skills), and topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.012 and 0.026 with respect to STS Connection) were critically misaligned. (Table 4.8)

8. At fine grain level, all the topics in question papers (Grade-X) from BISE (L) and written curriculum were misaligned with respect to Remember (percentage difference of content for SLO ranged from 2% to 75%), Understand (percentage difference of content for SLO ranged from 2% to 40%), Skills (Percentage difference of content for SLO ranged from 2%, to 55%), and STS Connection (Percentage difference of content for SLO ranged from 7%, to 56%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers (Grade-X) from BISE (L) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (L) had no item with respect to STS connection subcategory. (Figures 4.21- 4.24)

9. At fine grain level, there was significant misalignment (AI was 0.54) between written curriculum and question papers (Grade IX) by BISE (M). The topics 2a, 3b, 4a, 4b, 4d, 6b, and 7b (sum of RD ranged from 0.062 to 0.084) and subcategory STS connection (sum of RD was 0.091) were misaligned to the critical level. Similarly, topics 3a, 4c, and 8a (sum of RD ranged from 0.044 to 0.057) and subcategories Remember and Understand (sums of RD were 0.236 and 0.213) were significantly misaligned, while the topics 1a, 5a, and 9a (RD ranged from 0.033 to 0.042) and subcategory Skills (sum of RD was 0.213) were considerably misaligned. Moreover,

individually topics 2a, 3b, 4a, 4b, 4d, and 6b (RD ranged from 0.028 to 0.042 with respect to Remember), topics 4a, 4b, 4c, 6b, 7b, and 8a (RD ranged from 0.015 to 0.035 with respect to Understand), topics 2a, 3a, 3b, 4c, and 6b (RD ranged from 0.006 to 0.016 with respect to Skills), and topics 1a, 3a, 3b, 3c, 4d, and 8a (RD ranged from 0.011 and 0.016 with respect to STS Connection) were critically misaligned. (Table 4.9)

10. At fine grain level, most of the topics in question papers (Grade-IX) from BISE (M) and written curriculum were misaligned with respect to Remember (Percentage difference of content for SLO ranged from 2% to 75%), Understand (percentage difference of content for SLO ranged from 2% to 67%), Skills (Percentage difference of content for SLO ranged from 2%, to 69%), and STS Connection (Percentage difference of content for SLO ranged from 7%, to 30%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers (Grade-IX) from BISE (M) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (M) had no item with respect to STS connection subcategory. (Figures 4.25- 4.28)

11. At fine grain level, there was significant misalignment (AI was 0.50) between written curriculum and question papers (Grade X) by BISE (M). The topics 10b, 12a, 12b, 12c, 13b, 13c, 14b, 15b, 16b, and 18b (sum of RD ranged from 0.051 to 0.081) and subcategories Remember, Understand and STS connection (sum of RD ranged from 0.197 to 0.391) were misaligned to the critical level. Similarly, topics 10a, 11a, 14c, 15a, and 18a (sum of RD ranged from 0.039 to 0.047) and subcategory Skills (sum of RD was 0.0.187) were significantly misaligned. Moreover, individually topics 12a, 12b, 12c, 13b, 13c, 14b, 15a, 15b, 16b, and 18b (RD ranged from 0.020 to 0.040 with respect to Remember), topics 10a, 12b, 12c, 13b, 13c, 16b, 18a, and 18b (RD

ranged from 0.012 to 0.034 with respect to Understand), topics 10a, 11a, 11b, 12a, 12b, 14a, 14b, 14c, and 15b (RD ranged from 0.012 to 0.022 with respect to Skills), and topics 10b, 12b, 12c, 13c, 14a, 16b, 17b and 18b (RD ranged from 0.012 to 0.026 with respect to STS Connection) were critically misaligned. (Table 4.10)

12. At fine grain level, all the topics in question papers (Grade-X) from BISE (M) and written curriculum were misaligned with respect to Remember (Percentage difference of content for SLO ranged from 2% to 85%), Understand (percentage difference of content for SLO ranged from 2% to 72%), Skills (Percentage difference of content for SLO ranged from 8%, to 45%), and STS Connection (Percentage difference of content for SLO ranged from 7%, to 56%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers (Grade-X) from BISE (M) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (M) had no item with respect to STS connection subcategory. (Figures 4.29- 4.32)

13. At fine grain level, there was significant misalignment (AI was 0.57) between written curriculum and question papers (Grade IX) by BISE (N). The topics 1a, 2a, 3b, 4a, 4b, 4c, 4d, and 6b (sum of RD ranged from 0.057 to 0.084) and subcategory STS Connection (sum of RD was 0.091) were misaligned to the critical level. Similarly, topic 9a (sum of RD was 0.043) and subcategories Remember, Understand and Skills (sums of RD were 0.331, 0.220 and 0.224) were significantly misaligned. Moreover, individually topics 1a, 2a, 3b, 4a, 4b, and 6b (RD ranged from 0.030 to 0.042) with respect to Remember, topics 1a, 4a, 4d, 5a, 6b, 8a, and 9a (RD ranged from 0.014 to 0.022) with respect to Understand, topics 1b, 2a, 3a, 3b, 4c, and 6b (RD ranged from 0.016 to 0.024) with respect to Skills, and topics 1a, 3a, 3b, 3c, 4d, 8a,

and 9b (RD ranged from 0.006 to 0.016) with respect to STS Connection were critically misaligned. (Table 4.11)

14. At fine grain level, all the topics in question papers (Grade-IX) from BISE (N) and written curriculum were misaligned with respect to Remember (Percentage difference of content for SLO ranged from 4% to 80%), Understand (Percentage difference of content for SLO ranged from 5% to 42%), Skills (Percentage difference of content for SLO ranged from 3%, to 45%), and STS Connection (Percentage difference of content for SLO ranged from 7%, to 30%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers (Grade-IX) from BISE (N) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (N) had no item with respect to STS connection subcategory (Figures 4.33- 4.36).

15. At fine grain level, there was significant misalignment (AI was 0.55) between written curriculum and question papers (Grade X) by BISE (N). Moreover, topics 10a, 13a, 14b, and 15b (sum of RD ranged from 0.052 to 0.061) and subcategories Understand and STS Connection (sum of RD were 0.239 and 0.197 respectively) were misaligned to the critical level. Similarly, topics 10b, 11a, 11b, 12b, 12c, 15a, 16b, 17a, and 18b (sum of RD ranged from 0.040 to 0.048) subcategory Skills (sum of RD was 0.0.189) were significantly misaligned. Moreover, individually topics 11a, 11b, 15b, 17a, and18a (RD ranged from 0.022 to 0.025) with respect to Remember, topics 10a, 10b, 11b, 12a, 12b, 12c, 13a, 13c, 14b, 15b, 16b, and 17a (RD ranged from 0.011 to 0.024) with respect to Understand, topics 10a, 10b, 11b, 12a, 12b, 13a, 13b, and 14b (RD ranged from 0.011 to 0.027) with respect to Skills, and topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.012 to 0.026) with respect to STS Connection were critically misaligned. (Table 4.12)

16. At fine grain level, all the topics in question papers (Grade-X) from BISE (N) and written curriculum were misaligned with respect to Remember (Percentage difference of content for SLO ranged from 3% to 83%), Understand (Percentage difference of content for SLO ranged from 2% to 50%), Skills (Percentage difference of content for SLO ranged from 8%, to 38%), and STS Connection (Percentage difference of content for SLO ranged from 7%, to 56%) subcategories of cognitive demand. Moreover, mostly SLO percentages of question papers (Grade-X) from BISE (N) were higher with respect to Remember subcategory and fewer with respect to other subcategories. The question papers from BISE (N) had no item with respect to STS connection subcategory (Figures 4.37- 4.40).

5.2.3. Alignment Level of Taught Curriculum with Written Curriculum

1. There was considerable alignment (AI was 0.74) between written curriculum and the curriculum taught by Teachers (Group W1) at coarse grain level. However, the subcategory STS Connection (sum of RD was 0.128) was significantly misaligned. Similarly, sections A and E (sums of RD were 0.111 and 0.127) and subcategory Remember (sum of RD was 0.247) were considerably misaligned. Moreover, individually sections A and E (RD ranged from 0.055 to 0.063) were significantly misaligned with respect to Remember subcategory and sections D, E, and F (RD ranged from 0.020 to 0.030) were critically misaligned with respect to STS Connection subcategory. (Table 4.13)

2. There was considerable misalignment (AI was 0.69) between written curriculum and the curriculum taught by Teachers (Group W2) at coarse grain level. Moreover, the subcategory STS Connection (sum of RD was 0.139) was significantly misaligned. Similarly, sections A and E (sums of RD were 0.140 and 0.147) and subcategory Remember (sum of RD was 0.292) were considerably misaligned.

Moreover, individually sections A and E (RD ranged from 0.070 to 0.073) with respect to Remember and sections D, E and F (RD ranged from 0.026 to 0.031) with respect to STS Connection were critically misaligned. (Table 4.14)

3. There was significant misalignment (AI was 0.59) between written curriculum and the curriculum taught by Teachers (Group W3) at coarse grain level. Moreover, the subcategories Remember and STS Connection (sums of RD were 0.411 and 0.139 respectively) were critically misaligned. Similarly, sections B and E (sums of RD were 0.138 and 0.164) were significantly misaligned. Moreover, individually sections A, B and E (RD ranged from 0.069 to 0.092) with respect to Remember subcategory, section A (RD was 0.048) with respect to Skills subcategory, and sections A, D, E and F (RD ranged from 0.022 to 0.033) with respect to STS Connection subcategory were critically misaligned. (Table 4.15)

4. There was good alignment (AI was 0.86) between written curriculum and the curriculum taught by Teachers (Group W4) at coarse grain level. Moreover, this alignment was spread across all the sections (sum of RD range from 0.029 to 0.087). However, Remember subcategory of cognitive demand had relatively higher sum of RD than that of other subcategories. (Table 4.16)

5. At coarse grain level, there was misalignment between taught curriculum (Cluster W) and written curriculum in all the sections with respect to Remember (Percentage difference of content for SLO ranged from 20% to 56%), Understand (Percentage difference of content for SLO ranged from 1% to 17%), Skills (Percentage difference of content for SLO ranged from 1%, to 29%), and STS Connection (Percentage difference of content for SLO ranged from 1%, to 20%) subcategories of cognitive demand. Moreover, mostly SLO percentages of taught curriculum (Cluster W) were

higher with respect to Remember subcategory and fewer with respect to other subcategories, particularly STS Connection. (Figures 4.41- 4.44).

6. There was considerable alignment (AI was 0.71) between written curriculum and the curriculum taught by the Teachers (Group X1) at coarse grain level However, the sections A and F (sums of RD were 0.109 and 0.112 respectively) and subcategory STS Connection (sum of RD was 0.125) were considerably misaligned. Moreover, individually, sections A and E were significantly misaligned (RD ranged from 0.055 to 0.056) with respect to Remember, and sections B and E (RDs were 0.024 and 0.028) with respect to Understand as well as sections D and E (RD ranged from 0.026 to 0.029) with respect to STS Connection were considerably misaligned. (Table 4.17)

7. There was considerable misalignment (AI was 0.65) between written curriculum and the curriculum taught by the Teachers (Group X2) at coarse grain level. Moreover, the subcategories Remember and STS Connection (sums of RD were 0.346 and 0.138 respectively) were significantly misaligned. Similarly, sections A and E (sums of RD were 0.150 and 0.154) were significantly misaligned. Moreover, individually sections A and E were critically misaligned (RD were 0.069 and 0.092) with respect to Remember and sections D and E (RD were 0.022 and 0.033) with respect to STS Connection were critically misaligned. (Table 4.18)

8. There was significant misalignment (AI was 0.55) between written curriculum and the curriculum taught by the Teachers (Group X3) at coarse grain level. Moreover, the subcategories Remember and STS connection (sums of RD were 0.449 and 0.146 respectively) were critically misaligned. Similarly, sections A and E (sums of RD were 0.187 and 0.180) were also critically misaligned. Moreover, sections A, B, D, and E (RD ranged from 0.075 to 0.094) with respect to Remember, section A (RD 0.045) with respect to subcategory Skills, and Sections D, E and F (RD ranged from

0.028 to 0.032) with respect to STS Connection were critically misaligned. (Table 4.19)

9. There was a good level of alignment (AI was 0.88) between written curriculum and the curriculum taught by the Teachers (Group X4) at coarse grain level. Moreover, this alignment was spread across all the sections (sum of RD range from 0.052 to 0.091). However, section E had relatively higher (0.105) sum of RD and that was due to high (0.053) RD in Remember subcategory of cognitive demand. (Table 4.20)

10. At coarse grain level, there was misalignment between taught curriculum (Cluster X) and written curriculum in all the sections with respect to Remember (Percentage difference of content for SLO ranged from 16% to 56%), Understand (Percentage difference of content for SLO ranged from 1% to 21%), Skills (Percentage difference of content for SLO ranged from 1%, to 27%), and STS Connection (Percentage difference of content for SLO ranged from 1%, to 20%) subcategories of cognitive demand. Moreover, mostly SLO percentages of taught curriculum (Cluster X) were higher with respect to Remember subcategory and fewer with respect to other subcategories, particularly STS connection. (Figures 4.45- 4.48).

11. There was considerable level of misalignment (AI was 0.66) between written curriculum and the curriculum taught by Teachers (Group Y1) at coarse grain level. The subcategories Remember and STS Connection (sums of RD were 0.341 and 0.126 respectively) and sections A and E (sums of RD were 0.149 and 0.137) were significantly misaligned. Moreover, individually sections A and E (RDs were 0.068 and 0.075) with respect to Remember and sections D, E and F (RD ranged from 0.024 to 0.028) with respect to STS Connection were critically misaligned. (Table 4.21)

12. At coarse grain level, there was considerable level of misalignment (AI was 0.63) between written curriculum and the curriculum taught by Teachers (Group Y2). The subcategories Remember and STS Connection (sums of RD were 0.354 and 0.135 respectively) and sections A and E (sums of RD were 0.167 and 0.147) were significantly misaligned. Moreover, individually sections A, B and E (RD ranged from 0.066 to 0.083) with respect to Remember and sections D, E and F (RD ranged from 0.026 to 0.031) with respect to subcategory STS Connection were critically misaligned. (Table 4.22)

13. There was significant misalignment (AI was 0.59) between written curriculum and the curriculum taught by Teachers (Group Y3) at coarse grain level. The subcategory Remember (sum of RD was 0.405) and section E (sum of RD was 0.174) were critically misaligned while STS connection (sum of RD was 0.121) and sections A and D (sums of RD were 0.163 and 0.137 respectively) were significantly misaligned. Moreover, individually sections A, B, C, D, and E (RD ranged from 0.066 to 0.087) with respect to Remember and sections D, E and F (RD ranged from 0.025 to 0.031) with respect to subcategory STS Connection were critically misaligned. (Table 4.23)

14. There was a good level of alignment (AI was 0.81) between written curriculum and the curriculum taught by Teachers (Group Y4) at coarse grain level. Moreover, this alignment was spread across all the sections (sum of RD range from 0.018 to 0.090). However, section E had relatively higher (0.090) sum of RD and that was due to high (0.045) RD in remember subcategory of cognitive demand. (Table 4.24)

15. At coarse grain level, there was misalignment between taught curriculum (Cluster Y) and written curriculum in all the sections with respect to Remember (Percentage difference of content for SLO ranged from 4% to 49%), Understand (Percentage

difference of content for SLO ranged from 1% to 20%), Skills (Percentage difference of content for SLO ranged from 1%, to 26%), and STS Connection (Percentage difference of content for SLO ranged from 3%, to 19%) subcategories of cognitive demand. Moreover, mostly SLO percentages of taught curriculum (Cluster Y) were higher with respect to Remember subcategory and fewer with respect to other subcategories, particularly STS Connection. (Figures 4.49- 4.52).

16. There was a considerable level of alignment (AI was 0.72) between written curriculum and curriculum taught by Teachers (Group Z1) at coarse grain level. However, sections E (sum of RD was 0.259) was significantly misaligned and sections A and D (sums of RD were 0.111 and 0.107 respectively) as well as subcategory Remember (sum of RD was 0.259) were considerably misaligned. Moreover, individually sections A, D and E were significantly misaligned (RD ranged from 0.053 to 0.065) Remember subcategory and section E was critically misaligned (RD was 0.025) with respect to STS Connection subcategory. (Table 4.25)

17. At coarse grain level, there was considerable level of misalignment (AI was 0.65) between written curriculum and taught curriculum (Group Z2). The sections A, D, and E (RD ranged from 0.136 to 0.155) and the subcategory Remember (RD was 0.324) were significantly misaligned. Moreover, individually sections A, D and E were critically misaligned (RD ranged from 0.068 to 0.078) with respect to Remember and sections D and E (RD ranged from 0.28 to 0.029) with respect to subcategory STS Connection were critically misaligned. (Table 4.26)

18. At coarse grain level, there was considerable level of misalignment (AI was 0.61) between written and taught curricula (by Teachers of Group Z3). Sections A and D (sum of RD ranged from 0.132 to 0.143) and the subcategory Remember (sum of RD was 0.382) were significantly misaligned and section E (sum of RD was 0.174) was

misaligned to the critical level. Moreover, individually sections A, D and E (RD ranged from 0.072 to 0.087) with respect to Remember, and section E with respect to Understand (RD was 0.045) and STS Connection (RD was 0.027) were critically misaligned. (Table 4.27)

19. There was a significant level of alignment (AI was 0.80) between written and taught curricula by the Teachers (Group Z4) at coarse grain level. Moreover, this alignment was spread across all the sections (sum of RD range from 0.035 to 0.099). However, section E had relatively higher (0.099) sum of RD and that was due to high (0.049) RD in remember subcategory of cognitive demand. (Table 4.28)

20. At coarse grain level, there was misalignment between taught curriculum (Cluster Z) and written curriculum in all the sections with respect to Remember (percentage difference of content for SLO ranged from 2% to 53%), Understand (percentage difference of content for SLO ranged from 1% to 26%), Skills (Percentage difference of content for SLO ranged from 2%, to 22%), and STS Connection (Percentage difference of content for SLO ranged from 1%, to 18%) subcategories of cognitive demand. Moreover, mostly SLO percentages of taught curriculum (Cluster Z) were higher with respect to Remember subcategory and fewer with respect to other subcategories, particularly STS connection. (Figures 4.53- 4.56).

21. There was considerable misalignment (AI was 0.66) between written curriculum and the curriculum taught by Teachers (Group W1) to Grade IX students at fine grain level. The topics 2a, 4b and 6b (sum of RD ranged from 0.054 to 0.072) and subcategory STS Connection (sum of RD was 0.102) were misaligned to the critical level, topics 1a and 4a (sums of RD were 0.043 and 0.052) were significantly misaligned, and subcategories Remember and Skills (sums of RD were 0.272and 0.168 respectively) were considerably misaligned. Moreover, individually topics 2a,

4a, 4b and 6b (RD ranged from 0.021 to 0.035) with respect to Remember, topics 4b, 4c and 6b (RD ranged from 0.015 to 0.019) with respect to Understand, topics 2a, 4b and 4c, (RD ranged from 0.017 to 0.029) with respect to skills, and topics 1a, 4a, 4d, and 7a (RD ranged from 0.010 to 0.015) with respect to STS Connection were critically misaligned. (Table 4.29)

22. There was considerable misalignment (AI was 0.64) between written curriculum and the curriculum taught by Teachers (Group W2) to Grade IX students at fine grain level. The topics 1a, 2a, 3a, 3b, 4b, 4d, 6b and 9a (sum of RD ranged from 0.048 to 0.062) and subcategory STS Connection (sum of RD was 0.098) were misaligned to the critical level. Similarly, topic 4c (sum of RD was 0.045) and subcategory Remember (sum of RD was 0.324) were significantly misaligned. Moreover, topics 1a, 2a, 3a, 3b, 4b, 4d, 6b, and 9a (RD ranged from 0.024 to 0.030) with respect to Remember, topics 2a, 3b, 4b, 4c and 6b (RD ranged from 0.017 to 0.029) with respect to skills, and topics 1a, 2a, 3a, 3b, 4b, 4d, 6b and 9a (RD ranged from 0.011 to 0.015) with respect to STS Connection were critically misaligned. (Table 4.30)

23. There was significant misalignment (AI was 0.56) between written curriculum and the curriculum taught by Teachers (Group W3) to Grade IX students at fine grain level. The topics 2a, 3a, 3b, 4a, 4b, 4d and 6b (sum of RD ranged from 0.055 to 0.085) and subcategory Remember (sum of RD was 0.433) were misaligned to the critical level. Similarly, topics 1a, 1b, 5b, 6b, 7b, 8a, and 9a (sum of RD ranged from 0.043 to 0.052) and subcategories Skills and STS connection (sums of RD were 0.227 and 0.087 respectively) were significantly misaligned. Moreover, individually topics 1a, 1b, 2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, 8a and 9a (RD ranged from 0.022 to 0.042) with respect to Remember, topics 4b and 5b (RD ranged from 0.015 to 0.017) with respect to Understand , topics 1b, 2a, 3b, 4a and 6b (RD ranged from 0.015 to 0.035) with

respect to skills, and topics 1a, 3a, 3b, 4a and 4d (RD ranged from 0.010 to 0.016) with respect to STS Connection were critically misaligned (Table 4.31)

24. At fine grain level, there was significant alignment (AI was 0.82) between written curriculum and the curriculum taught by Group W4 to Grade IX students. Most of the topics (2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b and 9a) were comparatively more misaligned (sum of RD ranged from 0.050 to 0.085). On the other hand, there were some topics (6a, 8b and 9b) that were comparatively less misaligned (sum of RD ranged from 0.011to 0.020). As for as the sub categories of cognitive demand were concerned, the subcategories Remember and Skills were comparatively more misaligned (sum of RDs were 0.433 and 0.227) than the other subcategories. (Table 4.32)

25. There was considerable misalignment (AI was 0.68) between written curriculum and the curriculum taught by Teachers (Group W1) to Grade X students at fine grain level. The topics 13c, 16b and 18b (sums of RD ranged from 0.050 to 0.064) were misaligned to the critical level. Similarly, topics 10a, 10b, 12c and 15b (sum of RD ranged from 0.040 to 0.048) and STS Connection subcategory of cognitive domain (sum of RD was 0.177) were significantly misaligned. Moreover, individually topics 10a, 13c, 15b, and 16b (RD ranged from 0.019 to 0.025) with respect to Remember, topics 13c and 18b (RD ranged from 0.015 to 0.021) with respect to Understand, topics 10a, 13c and 18b (RD ranged from 0.010 to 0.017) with respect to skills, and topics 10b, 11b, 12c, 13a, 13c, 14a, 14c, 15a, 15b, 16b, 17b, and 18b (RD ranged from 0.006 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.33)

26. There was considerable misalignment (AI was 0.63) between written curriculum and the curriculum taught by Teachers (Group W2) to Grade X students at fine grain level. The topics 10b, 13c, 16b and 18b (sums of RD ranged from 0.051 to 0.064)

were misaligned to the critical level. Similarly, topics 12a, 12b, and 12c (sum of RD ranged from 0.040 to 0.045) and STS connection subcategory of cognitive domain (sum of RD was 0.178) were significantly misaligned. While Remember and Understand subcategories of cognitive demand were considerably misaligned (sums of RD were 0.299 and 0.143 respectively). Moreover, individually topics 12a, 12b, 12c, 13c, 16b, and 18b (RD ranged from 0.019 to 0.032) with respect to Remember, topics 10b, 13c and 18b (RD ranged from 0.011 to 0.019) with respect to Understand, topics 10a, and 12a (RD ranged from 0.010 to 0.014) with respect to skills, topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (RD ranged from 0.010 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.34)

27. There was significant misalignment (AI was 0.58) between written curriculum and the curriculum taught by Teachers (Group W3) to Grade X students at fine grain level. The topics 10a, 10b, 12b, 12c, 13a, 13c, 16b and 18b (sum of RD ranged from 0.049 to 0.074) and Remember subcategory of cognitive demand (sum of RD was 0.390) were misaligned to the critical level. Similarly, topics 12a, 14a and 15b (sum of RD ranged from 0.041 to 0.045) and STS Connection subcategory of cognitive domain (sum of RD was 0.188) were significantly misaligned. While Understand subcategory of cognitive demand was considerably misaligned (sum of RD was 0.150). Moreover, individually topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15b, 16b and 18b (RD ranged from 0.020 to 0.034) with respect to Remember, topics 11a, 12c, 13c and 18b (RD ranged from 0.011 to 0.021) with respect to Understand, topics 10a and 14b (RD ranged from 0.017 to 0.021) with respect to skills, and topics 10b, 11b, 12a, 12b, 12c, 13c, 14a, 14c, 15a, 15b, 16b, 17b and 18b (RD ranged from 0.006 to 0.026) with respect to STS Connection were critically misaligned (Table 4.35)

28. There was significant alignment (AI was 0.80) between written curriculum and the curriculum taught by Teachers (Group W4) to Grade X students at fine grain level. The sum of RD between written curriculum and the curriculum taught by Group W4 to Grade X students ranged from 0.008 to 0.040. The topics 12a, 12c, 13c, 16b, and 18b were comparatively less aligned (sum of RD ranged from 0.025 to 0.040). On the other hand, the topics 10b, 11a, 11b, 12a, 13a, 14b, 14c, 15b, and 18a were comparatively more aligned (sum of RD ranged from 0.008to 0.015). (Table 4.36)

29. At fine grain level, there was considerable misalignment (AI was 0.69) between written curriculum and the curriculum taught by Teachers (Group X1) to Grade IX students. The topics 4a and 4b (sums of RD were from 0.055 were 0.056) were misaligned to the critical level. The topics 2a, 6b and 9a (sums of RD ranged from 0.043 to 0.052) and STS Connection subcategory of cognitive demand (sum of RD was 0.083) were misaligned to the significant level. Moreover, individually topics 2a, 4a, 4b, 4d, 6b, and 18a (RD ranged from 0.019 to 0.027) with respect to Remember, topics 2a and 9a (RDs were 0.020 to 0.016 respectively) with respect to skills, and topics 1a, 3a, 3b, 4a, and 8a (RD ranged from 0.006 to 0.016) with respect to STS Connection were critically misaligned. (Table 4.37)

30. At fine grain level, there was considerable misalignment (AI was 0.62) between written curriculum and the curriculum taught by Teachers (Group X2) to Grade IX students. The topics 2a, 4b, 4d and 6b (sum of RD ranged from 0.058 were 0.070) were misaligned to the critical level. The topics 1a, 3a, 3b and 4a (sum of RD ranged from 0.043 to 0.053) and Remember and STS Connection subcategories of cognitive demand (sums of RD were 0.352 and 0.088 respectively) were misaligned to the significant level. Moreover, individually topics 2a, 3a, 3b, 4a, 4b, 4d and 6b (RD ranged from 0.025 to 0.033) with respect to Remember, topics 2a, 3b, 4b, and 4c

(RDs ranged from 0.016 to 0.031) with respect to skills, and topics 1a, 3a, 4a, 4d, 8a, and 9b (RD ranged from 0.006 to 0.015) with respect to STS Connection were critically misaligned. (Table 4.38)

31. At fine grain level, there was significant misalignment (AI was 0.54) between written curriculum and the curriculum taught by Teachers (Group X3) to Grade IX students. The topics 2a, 3b, 4a, 4b, 4d and 6b (sum of RD ranged from 0.065 to 0.083) and Remember subcategory of cognitive demand (sum of RD was 0.452) were misaligned to the critical level. The topics 1a, 1b, 3a, 4c, 5b, 8a and 9a (sum of RD ranged from 0.045 to 0.053) and Skills and STS Connection subcategories of cognitive demand (sums of RD were 0.224 and 0.088 respectively) were misaligned to the significant level. Moreover, individually most of the topics (RD ranged from 0.022 to 0.041) with respect to Remember, topics 1a, 4b and 6b (RDs ranged from 0.016 to 0.0.18) with respect to Understand, topics 1b, 2a, 3b, 4b, 4c, 6b and 9a (RDs ranged from 0.015 to 0.034) with respect to skills, and topics 1a, 3a, 3b, 4a and 4d (RD ranged from 0.010 to 0.016) with respect to STS Connection were critically misaligned. (Table 4.39)

32. There was considerable alignment (AI was 0.78) between written curriculum and the curriculum taught by Teachers (Group X4) to Grade IX students at fine grain level. However, the topics 2a, 4b, 6b and 9a were comparatively less aligned (sum of RD ranged from 0.035 to 0.045). On the other hand, topics 1a, 1b, 6a, 7a, 8b and 9b were comparatively more aligned (sum of RD ranged from 0.008 to 0.015). Moreover, the subcategories Remember and Understand were comparatively more misaligned (sum of RDs were 0.352 and 0.121) than the other subcategories. (Table 4.40)

33. At fine grain level, there was considerable misalignment (AI was 0.67) between written curriculum and the curriculum taught by Teachers (Group X1) to Grade X students. The topics 10b, 13c and 18b (sum of RD ranged from 0.050 to 0.054) were misaligned to the critical level. Similarly, topics 12b, 12c and 16b (sum of RD ranged from 0.039 to 0.048) and STS Connection subcategory of cognitive domain (sum of RD was 0.176) were significantly misaligned. While Remember subcategory of cognitive demand was considerably misaligned (sum of RD was 0.277). Moreover, individually topics 12b, 12c, 16b and 18b (RD ranged from 0.020 to 0.027) with respect to Remember, topics 13c and 18b (RD ranged from 0.014 to 0.016) with respect to Understand, topics 13c and 14b (RD range was 0.011) with respect to skills, and topics 10b, 12b, 12c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.010 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.41)

34. At fine grain level, there was considerable misalignment (AI was 0.62) between written curriculum and the curriculum taught by Teachers (Group X2) to Grade X students. The topics 10b, 12c, 13c, 16b and 18b (sum of RD ranged from 0.050 to 0.061) were misaligned to the critical level. Similarly, topics 10a, 12a, 12b and 15a (sum of RD ranged from 0.040 to 0.045) and Remember and STS Connection subcategories of cognitive domain (sums of RD were 0.341 and 0.175 respectively) were significantly misaligned. While Understand subcategory of cognitive demand was considerably misaligned (sum of RD was 0.132). Moreover, individually topics 10a, 10b, 12a, 12b, 12c, 13c, 15b, 16b and 18b (RD ranged from 0.019 to 0.030) with respect to Remember, topics 11a, 13c and 18b (RD ranged from 0.011 to 0.016) with respect to Understand, topic 10a (RD was 0.018) with respect to skills, and topics 10b, 12b, 12c, 13c, 15a, 16b, 17b and 18b (RD ranged from 0.010 to 0.025) with respect to STS Connection were critically misaligned. (Table 4.42)

35. At fine grain level, there was significant misalignment (AI was 0.55) between written curriculum and the curriculum taught by Teachers (Group X3) to Grade X students. The topics 10b, 12c, 13c, 15b, 16b and 18b (sum of RD ranged from 0.052 to 0.075) and Remember subcategory of cognitive demand (sum of RD was 0.433) were misaligned to the critical level. Similarly, topics 10a, 12a, 12b, 14a, 14c, 15a and 17a (sum of RD ranged from 0.039 to 0.048) and STS Connection subcategory of cognitive domain (sum of RD was 0.184) were significantly misaligned. While Understand subcategory of cognitive demand was considerably misaligned (sum of RD was 0.161). Moreover, individually topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 14b, 14c, 15b, 16b, 17a and 18b (RD ranged from 0.019 to 0.034) with respect to Remember, topics 11a, 13c, 16b, 17a and 18b (RD ranged from 0.011 to 0.021) with respect to Understand, topics 10a and 14b (RD range was 0.018) with respect to skills, and topics 10b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.010 to 0.026) with respect to STS Connection were critically misaligned. (Table 4.43)

36. There was considerable alignment (AI was 0.74) between written curriculum and the curriculum taught by Teachers (Group X4) to Grade X students at fine grain level. However, topics 10b, 12c, 13c, 14b, 15a, 16a and 18b were comparatively less aligned (sum of RD ranged from 0.031 to 0.046) and topics 11a and 18a were comparatively more aligned (sum of RD ranged from 0.008 to 0.013). The subcategories Remember and Understand were comparatively less aligned (sum of RDs were 0.239 and 0.093) than the other subcategories. (Table 4.44)

37. At fine grain level, there was considerable misalignment (AI was 0.62) between written curriculum and the curriculum taught by Teachers (Group Y1) to Grade IX students. The topics 2a, 4a, 4b and 4d (sum of RD ranged from 0.056 were 0.074) and STS Connection subcategory of cognitive demand (sums of RD 0.093) were

misaligned to the critical level. The topics 1b, 3b, 6b, and 9a (sum of RD ranged from 0.046 to 0.053) and Remember subcategory of cognitive demand (0.357 and 0.088 respectively) were misaligned to the significant level. Moreover, topics 1a, 1b, 2a, 3b, 4a, 4b, 4d, 6b and 9a (RD ranged from 0.020 to 0.035) with respect to Remember, topics 4b and 7b (RDs were 0.014 and 0.018) with respect to Understand, topics 1b, 2a, 4b and 9a (RDs ranged from 0.015 to 0.031) with respect to skills, and topics 1a, 3a, 3b, 4a and 4d (RD ranged from 0.009 to 0.015) with respect to STS Connection were critically misaligned individually. (Table 4.45)

38. At fine grain level, there was significant misalignment (AI was 0.58) between written curriculum and the curriculum taught by Teachers (Group Y2) to Grade IX students. The topics 2a, 3b, 4a, 4b, 4d and 6b (sum of RD ranged from 0.059 were 0.082) and STS connection subcategory of cognitive demand (sum of RD was 0.096) were misaligned to the critical level. The topics 1a, 3a, 4c, 7b and 9a (sum of RD ranged from 0.044 to 0.051) and Remember subcategory of cognitive demand (sum of RD was 0.397) were misaligned to the significant level. Moreover, individually topics 1a, 2a, 3a, 3b, 4a, 4b, 4c, 4d, 6b and 9a (RD ranged from 0.023 to 0.039) with respect to Remember, topics 1a, 4b, 5b, 6b and 7b (RDs ranged from 0.014 to 0.018) with respect to Understand, topics 2a, 4b, 4c and 6b (RDs ranged from 0.016 to 0.033) with respect to skills, and topics 1a, 3a, 3b, 4a, 4d, 8a and 9b (RD ranged from 0.006 to 0.015) with respect to STS Connection were critically misaligned. (Table 4.46)

39. At fine grain level, there was considerable misalignment (AI was 0.51) between written curriculum and the curriculum taught by Teachers (Group Y3) to Grade IX students. The topics 1a, 2a, 3b, 4a, 4b, 4c, 4d, 6b and 9a (sum of RD ranged from 0.054 were 0.080) and Remember and STS Connection subcategories of cognitive demand (sums of RD were 0.435 and 0.123 respectively) were misaligned to the

critical level. The topics 1b, 3a, 5b, 6a and 7b (sum of RD ranged from 0.043 to 0.046) were misaligned to the significant level. Understand and Skills subcategories of cognitive demand were considerably misaligned (sums of RD were 0.184 and 0.231 respectively). Moreover, individually most of the topics (RD ranged from 0.019 to 0.037) with respect to Remember, topics 1a, 4b, 5b, 6b, 7b and 9a (RDs ranged from 0.014 to 0.020) with respect to Understand, topics 1b, 2a, 4b, 4c, 6b and 9a (RDs ranged from 0.014 to 0.032) with respect to skills, and topics 1a, 3a, 3b, 4a, 4d, 5a, 6b, 8a and 9b (RD ranged from 0.006 to 0.013) with respect to STS Connection were critically misaligned. (Table 4.47)

40. There was considerable alignment (AI was 0.76) between written curriculum and the curriculum taught by Teachers (Group Y4) to Grade IX students at fine grain level. However, the topics 2a, 4b, 6b, and 9a were comparatively less aligned (sum of RD ranged from 0.034 to 0.048) and topics 4a, 5a, 5b, 7a, 8a and 8b were comparatively more aligned (sum of RD ranged from 0.017 to 0.019). The subcategories Remember and Skills were comparatively less aligned (sum of RDs were 0.177 and 0.132) than the other subcategories. (Table 4.48)

41. At fine grain level, there was considerable misalignment (AI was 0.64) between written curriculum and the curriculum taught by Teachers (Group Y1) to Grade X students. The topics 10b, 13c, 16b and 18b (sum of RD ranged from 0.052 to 0.061) were misaligned to the critical level. Similarly, topics 10a, 12b and 12c (sum of RD ranged from 0.041 to 0.044) as well as Remember (sum of RD was 0.327) and STS Connection (sum of RD was 0.170) subcategories of cognitive domain were significantly misaligned. While Understand subcategory of cognitive demand was considerably misaligned (sum of RD was 0.128). Moreover, individually topics 10a, 10b, 12b, 13c, 15b, 16b and 18b (RD ranged from 0.019 to 0.026) with respect to

Remember, topics 11a, 13c, 16b and 18b (RD ranged from 0.011 to 0.016) with respect to Understand, topics 10a and 14b (RD were 0.016 and 0.014) with respect to skills, and topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.010 to 0.026) with respect to STS Connection were critically misaligned. (Table 4.49)

42. At fine grain level, there was considerable misalignment (AI was 0.60) between written curriculum and the curriculum taught by Teachers (Group Y2) to Grade X students. The topics 10a, 10b, 13c, 16b and 18b (sum of RD ranged from 0.051 to 0.064) were misaligned to the critical level. Similarly, topics 12a, 12b, 12c and 14a (sum of RD ranged from 0.043 to 0.047) as well as Remember (sum of RD was 0.360) and STS Connection subcategories of cognitive domain (sum of RD was 0.178) were significantly misaligned. While Understand (sum of RD was 0.142) and Skills (sum of RD was 0.127) subcategories of cognitive demand were considerably misaligned. Moreover, individually topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 16b and 18b (RD ranged from 0.019 to 0.032) with respect to Remember, topics 11a, 13c and 18b (RD ranged from 0.015 to 0.019) with respect to Understand, topics 10a, 12a and 14b (RD ranged from 0.011 to 0.021) with respect to skills, and topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (RD ranged from 0.010 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.50)

43. At fine grain level, there was significant misalignment (AI was 0.50) between written curriculum and the curriculum taught by Teachers (Group Y3) to Grade X students. The topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15a, 15b, 16b and 18b (sum of RD ranged from 0.050 to 0.076) as well as Remember (sum of RD was 0.469) and STS Connection (sum of RD was 0.194) subcategories of cognitive demand were misaligned to the critical level. Similarly, topics 11b, 12a and 14c (sum of RD ranged

from 0.039 to 0.045) were significantly misaligned. While Understand and Skills subcategories of cognitive demand were considerably misaligned (sums of RD were 0.181 and 0.154 respectively). Moreover, individually topics 10a, 10b, 11a, 11b, 12a, 12b, 12c, 13c, 14a, 15b, 16b and 18b (RD ranged from 0.019 to 0.035) with respect to Remember, topics 11a, 12c, 13c and 18b (RD ranged from 0.011 to 0.022) with respect to Understand, topic 14b (RD was 0.017) with respect to skills, and topics 10b, 12b, 12c, 13c, 14a, 15a, 16b, 17b, and 18b (RD ranged from 0.011 to 0.026) with respect to STS Connection were critically misaligned. (Table 4.51)

44. There was considerable alignment (AI was 0.76) between written curriculum and the curriculum taught by Teachers (Group Y4) to Grade X students at fine grain level. However, the topics 10a, 10b, 12c, 13c, 14a, 16b and 18b were comparatively less aligned (sum of RD ranged from 0.030 to 0.038). On the other hand, topics 11b, 13a, 17a, 17b and 18a were comparatively more aligned (sum of RD ranged from 0.003 to 0.015). The subcategories Remember and STS Connection were comparatively more misaligned (sum of RDs were 0.209 and 0.108 respectively) than the other subcategories. (Table 4.52)

45. At fine grain level, there was considerable misalignment (AI was 0.65) between written curriculum and the curriculum taught by Teachers (Group Z1) to Grade IX students. The topics 2a and 4b (sums of RD were 0.071 and 0.055) and STS Connection subcategory of cognitive demand (sum of RD was 0.137) were misaligned to the critical level. The topics 1a, 1b, 3b, 4a, 4d and 6b (sum of RD ranged from 0.044 to 0.052) were misaligned to the significant level. Remember and Understand subcategories of cognitive demand were considerably misaligned (sums of RD were 0.268 and 0.147 respectively). Moreover, individually topics 2a, 3a, 3b, 4a, 4b and 4d (RD ranged from 0.021 to 0.026) with respect to Remember, topic 4b (RD was

0.0.015) with respect to Understand, and topics 1a, 1b, 2a, 3a, 3b, 4a, 4b, 4d, 5a, 7a and 7b (RD ranged from 0.006 to 0.014) with respect to STS Connection were critically misaligned. (Table 4.53)

46. At fine grain level, there was considerable misalignment (AI was 0.60) between written curriculum and the curriculum taught by Teachers (Group Z2) to Grade IX students. The topics 2a, 4a, 4b and 6b (sum of RD ranged from 0.054 were 0.073) and STS Connection subcategory of cognitive demand (sum of RD was 0.131) were misaligned to the critical level. The topics 1a, 3a, 3b, 4d and 9a (sum of RD ranged from 0.045 to 0.053) and Remember subcategory of cognitive demand (sum of RD was 0.323) were misaligned to the significant level. Understand and Skills subcategories of cognitive demand were considerably misaligned (sums of RD were 0.150 and 0.191 respectively). Moreover, individually topics 2a, 3a, 3b, 4a, 4b, 4d and 9a (RD ranged from 0.023 to 0.031) with respect to Remember, topics 1a, 4b and 6b (RDs ranged from 0.014 to 0.018) with respect to Understand, topics 2a, 4b, 4c and 9a (RDs ranged from 0.015 to 0.0.31) with respect to skills, and topics 1a, 1b, 2a, 3a, 3b, 4a, 4d, 5a, 6a, 6b, 7a and 9b (RD ranged from 0.006 to 0.012) with respect to STS Connection were critically misaligned. (Table 4.54)

47. At fine grain level, there was significant misalignment (AI was 0.53) between written curriculum and the curriculum taught by Teachers (Group Z3) to Grade IX students. The topics 2a, 3b, 4a, 4b, 4d, 6b and 9a (sum of RD ranged from 0.055 were 0.079) as well as Remember and STS Connection subcategories of cognitive demand (sums of RD were 0.406 and 0.128 respectively) were misaligned to the critical level. The topics 1a, 1b, 3a, 5b, 7b and 8b (sum of RD ranged from 0.044 to 0.055) and Skills category of cognitive demand (sum of RD was 0.223) were misaligned to the significant level. Understand subcategory of cognitive demand was considerably

misaligned (sum of RD was 0.182). Moreover, individually, topics 2a, 3a, 3b, 4a, 4b, 4d, 5b, 6b, 8b and 9a (RD ranged from 0.023 to 0.033) with respect to Remember, topics 1a, 4b, 5b, 6b, 7b and 9a (RDs ranged from 0.014 to 0.0.19) with respect to Understand, topics 2a, 4b, 4c, 6b and 9a (RDs ranged from 0.015 to 0.0.31) with respect to skills, and topics 1a, 1b, 2a, 3a, 3b, 4a,4b, 4d, 5a, 6a, 6b, 7a and 8b (RD ranged from 0.006 to 0.013) with respect to STS Connection were critically misaligned. (Table 4.55)

48. At fine grain level, there was considerable alignment (AI was 0.74) between written curriculum and the curriculum taught by Teachers (Group Z4) to Grade IX students. However, the topics 4b and 6b were comparatively less aligned (sum of RD 0.054). On the other hand, topics 5a, 8b, and 9b were comparatively more aligned (sum of RD ranged from 0.010 to 0.015). Similarly, the subcategories Remember and Skills were comparatively more misaligned (sum of RDs were 0.214 and 0.131 respectively) than the other subcategories. (Table 4.56)

49. At fine grain level, there was considerable misalignment (AI was 0.66) between written curriculum and the curriculum taught by Teachers (Group Z1) to Grade X students. The topics 13c and 18b (sum of RD were 0.055 to 0.057 respectively) were misaligned to the critical level. Similarly, topics 10a, 10b, 12c and 16b (sum of RD ranged from 0.041 to 0.048) as well as STS Connection (sum of RD was 0.166) subcategories of cognitive demand were significantly misaligned. While Remember and Understand subcategories of cognitive demand were considerably misaligned (sums of RD were 0.285 and 0.144 respectively). Moreover, individually, topics 10a, 12b, 12c, 13c, 16b and 18b (RD ranged from 0.019 to 0.024) with respect to Remember, topics 11a, 16b and 18b (RD ranged from 0.011 to 0.016) with respect to Understand, topic 10a (RD was 0.020) with respect to skills, and topics 10b, 12c, 13c,

14a, 15a, 16b, 17b, and 18b (RD ranged from 0.010 to 0.020) with respect to STS Connection were critically misaligned. (Table 4.57)

50. At fine grain level, there was significant misalignment (AI was 0.58) between written curriculum and the curriculum taught by Teachers (Group Z2) to Grade X students. The topics 10b, 12b, 13c, 16b and 18b (sum of RD ranged from 0.049 to 0.064) were misaligned to the critical level. Similarly, topics 10a, 12a, 12c, 14a, 14c, 15a, 15b and 17b (sum of RD ranged from 0.041 to 0.047) as well as Remember (sum of RD was 0.367), Understand (sum of RD was 0.171), and STS Connection (sum of RD was 0.170) subcategories of cognitive demand were significantly misaligned. While Skills subcategory of cognitive demand was considerably misaligned (sum of RD was 0.141). Moreover, individually, topics 10a, 12a, 12b, 12c, 14a, 14c, 15a, 15b, 16b and 18b (RD ranged from 0.020 to 0.030) with respect to Remember, topics 10b, 11a, 13c, 16b and 18b (RD ranged from 0.011 to 0.019) with respect to Understand, topics 10a and 14b (RDs were 0.016 and 0.018) with respect to skills, and topics 10b, 12c, 13c, 14a, 15a, 16b, 17b and 18b (RD ranged from 0.010 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.58)

51. At fine grain level, there was significant misalignment (AI was 0.51) between written curriculum and the curriculum taught by Teachers (Group Z3) to Grade X students. The topics 10a, 10b, 12b, 12c, 13c, 14a, 14c, 15a, 15b, 16b and 18b (sum of RD ranged from 0.049 to 0.066) as well as Remember (sum of RD was 0.451) category of cognitive demand were misaligned to the critical level. Similarly, topics 12a and 14b (sum of RD ranged from 0.040 to 0.047) as well as Understand (sum of RD was 0.191) and STS Connection (sum of RD was 0.183) subcategories of cognitive demand were significantly misaligned. While Skills subcategory of cognitive demand was considerably misaligned (sum of RD was 0.162). Moreover,

individually, topics 10a, 10b, 12a, 12b, 12c, 13c, 14a, 15a, 15b, 16b and 18b (RD ranged from 0.020 to 0.031) with respect to Remember, topics 11a, 13c, 16a, 16b and 18b (RD ranged from 0.011 to 0.020) with respect to Understand, topics 10a and 14b (RDs were 0.024 and 0.016 respectively) with respect to skills, and topics 10b, 12c, 15a, 16b, 17b and 18b (RD ranged from 0.011 to 0.024) with respect to STS Connection were critically misaligned. (Table 4.59)

52. There was considerable alignment (AI was 0.74) between written curriculum and the curriculum taught by Teachers (Group Z4) to Grade X students at fine grain level. However, topics 10a, 13c, and 18b were comparatively less aligned (sum of RD ranged from 0.037 to 0.047). On the other hand, topics 13a, 17a, and 18a were comparatively more aligned (sum of RD ranged from 0.005 to 0.016). As for as the sub categories of cognitive demand were concerned, the subcategories Remember and STS Connection were comparatively more misaligned (sum of RDs were 0.201 and 0.118 respectively) than the other subcategories. (Table 4.60)

5.3. Discussion

The first objective of the study was to discover the alignment of supported curriculum with the written curriculum. This objective was achieved through two questions viz. (a) To what extent do the contents of the text books cover the students learning outcomes given in the written curriculum? (b) How much do materials mentioned in the written curriculum are available in schools? In answer to first question it was found that the textbooks were considerably aligned (AI 0.72) with the written curriculum at coarse grain level. However, some sections individually were misaligned, which was due to overemphasis on Remember subcategory and neglecting the STS connection. Similarly, at fine grain level Biology-IX textbook was considerably aligned (AI =0.74). However, Biology X textbook was considerably misaligned (AI= 0.68). These findings partially agree with those of Akhtar (2004), Rehman (2004) and Faize (2011) who found that the content in the textbooks were overloaded and was not helpful in achieving the desired objectives.

There were three main factors responsible for this misalignment of Biology-X textbook with written curriculum at fine grain level and these factors were:

(a) Biology-X textbook provided more content with respect to Remember category

(b) In Biology-X textbook there was less content with respect to Understand category

(c) There was no content with respect to STS Connection category in Biology-X textbook.

Therefore, less content for Remember category, more content for Understand category and adequate content for STS Connection category is required for good alignment between the content of textbooks and the written curriculum. The textbook writers have the limitation of confining the content to limited pages. However, the limitation of number of pages cannot be justified at the cost of no or less content for SLO mentioned in the written curriculum. It is not enough to provide content about SLO, but more important is providing content according to the requirement of SLO, particularly nature of its cognitive domain of SLO.

With reference to the research question "How much do materials mentioned in the written curriculum are available in schools", it was found that the schools were deficient in materials mentioned in the written curriculum. A few articles were available in all the schools. Half of the total schools had only half of the materials mentioned in the written curriculum. This misalignment of resources mentioned in the curriculum indicated lack of coordination between curriculum developers and the school education management.

The research question "How much is the taught curriculum aligned with the written curriculum?" was developed for achieving the objective "Determine alignment of taught curriculum with the written curriculum". With reference to this question it was found that only the curriculum taught by teachers of cluster 4 was aligned (AI 0.84 at coarse grain level, AI 0.72 & 0.76 at fine grain level) with the written curriculum. However, curriculum taught by teachers of other clusters was misaligned (Cluster 1=AI 0.65 & 0.66, cluster 3=AI 0.59 & AI 0.54) with the written curriculum. These findings further endorse Faize's (2011, p.216) recommendation about earnest need of "consistency" between policy making and its execution. These findings also give further detail of studies by Hussain (2012) and Rehman (2012) which suggest that teachers in Pakistan employ conventional teaching methods which do not help in conceptual understanding of the content and encourage only rote-learning.

The degree of misalignment of taught curriculum with the written curriculum was higher than that of between the written curriculum and the textbook. Moreover, the textbooks had more content SLO relating to Remember subcategory and less content relating to Understand category. Similarly, the teachers also provided more content SLO relating to Remember subcategory and less content relating to Understand category. All this indicated that teachers mostly used only textbook for instruction in the classroom. This may be one reason of misalignment of taught curriculum with the written curriculum. It also indicated lack of awareness of teachers about the written curriculum. Moreover, the question papers administered to the students were also misaligned with the written curriculum. As classroom instruction is influenced by the nature of assessment, the teachers are satisfied with the content that enables students to perform well in the examinations. So, misalignment of textbook with the written curriculum, misalignment of question papers with the written curriculum, and inappropriate qualification of teachers are the major reasons behind the misalignment of taught curriculum with the written curriculum.

For finding out the alignment of the assessed curriculum with the written curriculum, the research question was "To what degree are the question papers congruent with the written curriculum?" With respect to this question it was found that Question Papers administered by BISEs were considerably aligned at coarse grain level (AI for BISEs L, M & N were 0.68, 0.71, & 0.74 respectively). However, Question Papers administered by BISEs were significantly misaligned at fine grain level (AI for Question Papers-IX by BISEs L, M & N were 0.52, 0.54, & 0.57 respectively and AI for Question Papers-X by BISEs L, M & N were 0.50, 0.50, & 0.55 respectively). Kanwal (2001) also found imbalance in distribution of items relating to categories of objectives in the textbook and the examination papers in the subject of English. These findings endorse studies conducted by Shah and Tariq (1986-87), Rehman (2004), Naeem Ullah (2007), and Faize (2011) as they found that examinations encouraged rote-memorization and lacked proper representation of content.

The alignment level between the written curriculum and the question papers is comparatively better at coarse grain level than at fine grain level. It indicated that there was proper distribution of items at section level. However, this distribution of items did not match the written curriculum at topic level. The items for assessing SLO differed for every topic proposed in the written curriculum. Moreover, there was also difference of emphasis on every topic with reference to cognitive complexity. The alignment level can be increased if items for question papers from topics are selected in proportion of number and nature of SLO proposed in written curriculum.

5.4. Conclusions

On the basis of findings following conclusions were drawn:

1. The gap between the textbooks and the written curriculum indicated lack of coordination between the curriculum developers and the textbooks writers. This deduction was reinforced by the fact that none of the textbook writers participated in the process of curriculum development as the list of curriculum developers did not contain the name of any one of the textbook writers. For the textbook writers it is essential that almost throughout the province classrooms instruction is dominated by the single textbooks for a particular subject and most of the teachers take textbooks as the written curriculum. The textbooks are supposed to contain all the knowledge and skills a student is expected to learn or acquire. Therefore, it is essential that the textbooks contain the content which is sufficient to achieve all the SLO suggested in the written curriculum. Textbooks of Biology-IX and Biology-X contained content about all the topics mentioned in the written curriculum. However, it is not enough, the textbooks must provide the content about a topic to the breadth and depth as suggested in the written curriculum. This would facilitate achieving the SLO given in the written curriculum. Biology-IX and Biology-X textbooks provided content for achieving SLO relating to lower level of

cognitive demand. For most of the topics, the written curriculum suggested SLO relating to higher level of cognitive demand but the textbooks provided content that was limited to achieving SLO relating to lower level cognitive demand. This caused misalignment between the written curriculum and the textbooks. This necessitates revision of content by the textbook writers.

2. Biology-IX and Biology-X textbooks provided no content for achieving SLO relating to STS Connection. It may not only make the book less interesting but also lead towards unattractive instruction. Content for SLO relating to STS in the textbooks is essential for enhancing awareness of the learners about the society as well as understanding the developments in technology.
3. Ensuring availability of the instructional materials mentioned in the written curriculum in all the schools is responsibility of educational administration. The gap found between the necessary materials mentioned in the written curriculum and the availability of these materials in school may lead not only towards misaligned instruction but also misaligned assessment. This necessitates proper planning by the educational administration for provision of necessary instructional materials.
4. Assessment in education system has been criticized by many educationists. Most significant reason behind this criticism is that the students are forced to reproduce the facts learnt in classrooms. Students' assessment loses its importance if it is not comprehensive and it fails to assess all the faculties of students. This happened with the assessment conducted by BISEs in Punjab. Most of the items in Question papers of Biology-IX & X administered by BISEs assessed the content relating to lower level of cognitive demand. These items required the students to reproduce the facts only. The number of items

assessing the higher level of cognitive demand was much less. It was contrary to the specifications given in the written curriculum and it caused the misalignment between the Question papers and the written curriculum.

5. The findings about the question papers administered by BISEs indicated need of proper training for examiners, evaluation manuals and proper evaluation of the question papers if these are aligned with the written curriculum. The question papers administered by BISEs must contain the items for assessing the content relating to SLO of different categories of cognitive demand in the same proportion as suggested in the written curriculum. Moreover, the proportion of distribution of items relating to content for SLO of different categories of cognitive demand was similar to that of found in textbooks. It may be inferred that the question papers were developed according to the textbooks. Therefore, it is important for the paper setters to follow the table of specification given in the written curriculum. Moreover, while selecting items for question papers main focus must be achieving SLO proposed in the written curriculum.
6. It was noticeable that the misalignment between the written curriculum and the curriculum taught by most of the teachers was because teachers over-emphasized the content relating to SLO of lower level of cognitive demand. They provided much less content relating to SLO of higher level of cognitive demand and even ignored content relating to SLO of STS subcategory. The textbooks also provided more content about SLO relating to lower level of cognitive demand, much less content for the SLO relating to higher level of cognitive demand and no content for SLO relating to STS subcategory. All this indicated that most of teachers' instruction was confined to just content in

the textbooks. Several studies done on classroom instruction in Pakistan also endorse this. So, it calls for attention of educational authorities for planning about multiple instructional packages in place of one textbook.

7. The instruction of teachers with better relevant academic and professional degrees (i.e. M.Ed) was more aligned with the written curriculum. It is very important for educational administration. Recruiting teachers with relevant academic and better professional qualification can facilitate much in making classroom instruction aligned with the written curriculum. Keeping in view the financial constraints, it would not be possible to make such arrangements. However, the special in-service training programmes for in-service teachers can be very useful.
8. The misalignment of textbooks and Question papers with the written curriculum affects the nature of content taught by the teachers. Teachers prefer to teach that content which is helpful for the students to do well in the examinations. The findings also indicated that teachers emphasized the content relating to those SLO which were important from examination point of view.

5.5. Recommendations

Based on findings and conclusions it is recommended that:

1. The Biology textbooks for Grade IX & X may be reviewed to make it aligned with the written curriculum. Particularly, content about all the subcategories mentioned in the written curriculum may be provided. Moreover, mostly, it has been complained that the textbooks are devoid of interest. No content in the textbooks about STS Connection may be one reason of this lack of interest.

So, it is recommended that content relating to STS connection may be provided.

2. The Biology textbooks may provide more content about topic numbers 4b, 6b, 9a, 10b 13c, 14a, 14c, 16b, and 17c with respect to understand category.
3. The Biology textbooks may provide less content about topic numbers 10b, 12c, 13c, 14a, 14c, 15a, 16b, 17a, 17b, and 18b with respect to Remember category.
4. For making assessment more aligned with the written curriculum, the examination papers may contain fewer items about topic numbers 1a, 1b, 6a, 7b, 10b, 11b, 12a, 12b, 12c, 13c, 14b, 15a, and 16b relating to Remember category of cognitive demand.
5. More items about topic numbers 1a, 1b, 2a, 4b, 5a, 6a, 10a, 11a, 14a, 15b, 16a, and 16b relating to Understand category of cognitive demand in the question papers by BISEs may increase alignment between the assessment and the written curriculum.
6. In the written curriculum a table of specification is given. This table gives detail of how many items to select from any topic. It also gives relative emphasis on categories of cognitive demand. While selecting items for question papers, it is recommended that this table of specification may be followed.
7. The number of items in question papers relating to STS connection may be included.
8. Teachers having proper and relevant educational qualification (Master degree in Zoology or Botany and Education) may be appointed. Moreover, awareness

about written curriculum may be included in the content of in-service teachers training programmes.

9. Dissemination of written curriculum document to every teacher as well as educational managers may be ensured.
10. The sections B, C and E in the written curriculum may be reviewed because these sections are contributing much in the misalignment.
11. Introducing practice of "curriculum mapping" in every District may be initiated because every District has teachers whose teaching is aligned with the written curriculum. The curriculum mapping practices would enable the teachers to share their ideas and enhance understanding of the written curriculum.
12. In-service teacher training that effectively combines knowledge of the content and skills suggested in written curriculum may be very helpful in making instruction aligned with the written curriculum. Thus, if the resource persons of teachers' training have adequate knowledge of curriculum, they are more likely to reshape the attitudes, remodel the habits, and reconstitute the personality of the teacher in accordance with the demands of the written curriculum. Therefore, in-service teacher training policy may be revised to give significant place for raising understanding of written curriculum.
13. The efficient use of educational technology by teachers at schools can show significant improvement in quality of instruction. New Information and Communication Technologies can be very helpful in improving classroom instruction, students' learning as well as laboratory experience. The school management may devise effective plan for making best use of new Information and Communication Technologies.

14. Awareness to teachers about Open Educational Resources may be very helpful. Teachers can improve the quality of teaching and learning through making use of Open Educational Resources. Therefore, for improving the quality of teaching and learning, it would be very helpful that written curriculum and textbooks enlist relevant Open Educational Resources. It would not only raise awareness about these resources but also enhance the adequate usage of these resources.

5.6. Recommendations for Further Research

The present study raised new questions that may be investigated. For example, studies may be undertaken to:

1. Find out the factors affecting alignment of taught, supported and assessed curricula with written curriculum.
2. Alignment of different types of curriculum with respect to other subjects and other geographical areas.
3. Compare alignment of different types of curriculum across Teachers and geographical areas may be undertaken.
4. Analyse the written curriculum.

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CODES USED

Appendix A1: For Districts

District	Code	District	Code
Dera Ghazi Khan	W	Jhang	Y
Multan	X	Muzaffargarh	Z

Appendix A2: For BISEs

District	Code
BISE Dera Ghazi Khan	L
BISE Multan	M
BISE Faisalabad	N

Appendix A3: Clusters of Teachers

Cluster	Code
M.Phil/MS and MSc/BSc Honours (Botany/Zoology)	1
BSc Biology (B.Ed)	2
BSc (Biology or other than Biology subjects)	3
MSc or BSc and M.Ed.	4

Appendix A4: For Teachers

District	Code	District	Code
M.Phil/MS or MSc/BSc Honours (Botany/Zoology) of Dera Ghazi Khan	**W1**	BSc Biology (B.Ed) of Dera Ghazi Khan	**W2**
BSc (Biology or other than Biology subjects) of Dera Ghazi Khan	**W3**	MSc or BSc and M.Ed. of Dera Ghazi Khan	**W4**
Multan M.Phil/MS and MSc/BSc Honours (Botany/Zoology) of Multan	**X1**	BSc Biology (B.Ed) of Multan	**X2**
BSc (Biology or other than Biology subjects) of Multan	**X3**	MSc or BSc and M.Ed. of Multan	**X4**
Jhang M.Phil/MS and MSc/BSc Honours (Botany/Zoology) of Jhang	**Y1**	BSc Biology (B.Ed) of Jhang	**Y2**
BSc (Biology or other than Biology subjects) of Jhang	**Y3**	MSc or BSc and M.Ed. of Jhang	**Y4**
Muzaffargarh M.Phil/MS and MSc/BSc Honours (Botany/Zoology) of Muzaffargarh	**Z1**	BSc Biology (B.Ed) of Muzaffargarh	**Z2**
BSc (Biology or other than Biology subjects) of Muzaffargarh	**Z3**	MSc or BSc and M.Ed. of Muzaffargarh	**Z4**

Appendix A5: For Sections

Section No.	Title of Section	Code
1	STUDY OF LIFE & BIODIVERSITY	**A**
2	CELL BIOLOGY	**B**
3	LIFE PROCESSES	**C**
4	CONTINUITY IN LIFE	**D**
5	ECOLOGY	**E**
6	APPLICATION OF BIOLOGY	**F**

Appendix A6: For Topics Class 9th

Sr. No.	Topic	Code
1.	Biology	**1a**
2.	Levels of Organization	**1b**
3.	Biological Method	**2a**
4.	1. Definition and Introduction of Biodiversity 2. Aims and Principles of Classification 3. History of Classification Systems 4. The Five Kingdoms 5. Binomial Nomenclature	**3a**
5.	Conservation of biodiversity in Pakistan	**3b**
6.	Microscopy and Emergence of Cell Theory	**4a**
7.	Cellular Structures and Functions	**4b**
8.	Active and Passive Transport of matter	**4c**
9.	Tissues	**4d**
10.	1. Cell Cycle and its phases 2. Mitosis	**5a**
11.	1. Meiosis 2. Necrosis and Apoptosis	**5b**
12.	1. Definition & Characteristics of Enzymes 2.Mechanism of Enzyme Action	**6a**
13.	Specificity of Enzymes	**6b**
14.	1. Introduction and the Role of ATP 2.Photosynthesis	**7a**
15.	Respiration	**7b**
16.	1. Nutrition in Plants 2. Nutrition in Man	**8a**
17.	Digestion in Man & Disorders of Gut	**8b**
18.	Transport in Plants	**9a**
19.	Transport in Man	**9b**

Appendix A7: For Topics Class 10th

Sr. No.	Topic	Code
20.	1.Introduction to Gaseous Exchange 2. Gaseous Exchange in plants 3. Gaseous Exchange in Man	**10a**
21.	Respiratory Disorders and their Causes	**10b**
22.	Homeostasis in Plants & Man	**11a**
23.	1. Urinary system of Man 2. Disorders of Human Excretory System	**11b**
24.	1.Introduction and Types of Coordination 2. Human Nervous System	**12a**
25.	Major Human Receptors	**12b**
26.	1. Endocrine System 2. Nervous Disorders (Paralysis and Epilepsy)	**12c**
27.	Human Skeleton	**13a**
28.	1. Types of joints 2. Muscles and movement	**13b**
29.	Disorders of Skeletal System (Arthritis and Osteoporosis)	**13c**
30.	1. Introduction to Reproduction 2. Asexual Reproduction in Plants	**14a**
31.	Sexual Reproduction in Plants	**14b**
32.	1. Asexual Reproduction in Animals 2. Sexual Reproduction in Animals	**14c**
33.	1. Introduction to Inheritance 2. Chromosomes and Genes	**15a**
34.	1. Mendal's Laws 2. Variation and Evolution	**15b**
35.	1. The Ecosystem: Levels of Ecological Organization; Components 2. Flow of materials and energy in the ecosystem 3.Biogeochemical Cycles (Carbon Cycle & Nitrogen Cycle)	**16a**
36.	1. Interactions in the Ecosystem 2. Ecosystem Balance and Human impact on environment 3. Pollution, its Consequences and Control 4. Conservation of Nature	**16b**
37.	1. Introduction to Biotechnology 2.Fermentation	**17a**
38.	1. Genetic Engineering 2. Single Cell Protein and its Uses	**17b**
39.	1. Introduction to Pharmacology & Medicinal Drugs 2. Addictive Drugs	**18a**
40.	Antibiotics and Vaccines	**18b**

Appendix B

Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values

Appendix B1: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Grain level Subcategories)

Sr. No.	Level of Alignment	Alignment Index [AI]	Sum of Ratio Difference [RD] with respect to			
			Remember	Understand	Skills	STS
1	Good Alignment	0.9-1	0.078 & below	0.046 & below	0.048 & below	0.028& below
2	Significant Alignment	0.8-0.9	0.156-0.079	0.092-0.047	0.096-0.049	0.056-0.029
3	Considerable Alignment	0.7-0.8	0.234-0.157	0.138-0.093	0.144-0.97	0.084-0.057
4	Considerable Misalignment	0.6-0.7	0.312-0.235	0.184-0.139	0.192-0.145	0.112-0.085
5	Significant Misalignment	0.5-0.6	0.390-0.313	0.230-0.185	0.240-0.103	0.140-0.113
6	Critical Misalignment	below0.5	Above 0.390	Above 0.230	Above 0.240	Above 0.140

Appendix B2: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Grain level; Sections Individually)

Sr. No.	Level of Alignment	Alignment Index [AI]	Ratio Difference [RD] with respect to				
			Remember	Understand	Skills	STS	Total
1	Good Alignment	0.9-1	0.013 & below	0.008 & below	0.008 & below	0.005 & below	0.033 & below
2	Significant Alignment	0.8-0.9	0.026-0.014	0.015-0.009	0.016-0.009	0.009-0.006	0.067-0.034
3	Considerable Alignment	0.7-0.8	0.039-0.27	0.023-0.016	0.024-0.017	0.014-0.010	0.1-0.068
4	Considerable Misalignment	0.6-0.7	0.052-0.040	0.31-0.24	0.032-0.025	0.019-0.015	0.133-0.099
5	Significant Misalignment	0.5-0.6	0.065-0.053	0.038-0.032	0.04-0.033	0.023-0.020	0.167-0.134
6	Critical Misalignment	below0.5	Above 0.065	Above 0.038	Above 0.04	Above 0.023	Above 0.167

Appendix B3: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Fine grain level (Grade IX); Subcategories)

Sr. No.	Level of Alignment	Alignment Index [AI]	Sum of Ratio Difference [RD] with respect to			
			Remember	Understand	Skills	STS
1	Good Alignment	0.9-1	0.08 & below	0.048 & below	0.054 & below	0.018 & below
2	Significant Alignment	0.8-0.9	0.16-0.081	0.096-0.049	0.108-0.055	0.036-0.019
3	Considerable Alignment	0.7-0.8	0.24-0.161	0.144-0.097	0.162-0.109	0.054-0.034
4	Considerable Misalignment	0.6-0.7	0.32-0.241	0.192-0.145	0.216-0.163	0.072-0.055
5	Significant Misalignment	0.5-0.6	0.4-0.321	0.24-0.193	0.27-0.217	0.09-0.073
6	Critical Misalignment	below0.5	Above 0.4	Above 0.24	Above 0.27	Above 0.09

Appendix B4: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Fine grain level (Grade IX); Topics Individually)

Sr. No.	Level of Alignment	Alignment Index [AI]	Ratio Difference [RD] with respect to				
			Remember	Understand	Skills	STS	Total
1	Good Alignment	0.9-1	0.004 and below	0.003 and below	0.003 and below	0.001 and below	0.011 and below
2	Significant Alignment	0.8-0.9	0.008-0.005	0.005-0.004	0.006-0.004	0.002	0.012-0.021
3	Considerable Alignment	0.7-0.8	0.013-0.009	0.008-0.006	0.009-0.007	0.003	0.022-0.032
4	Considerable Misalignment	0.6-0.7	0.017-0.014	0.010-0.009	0.011-0.010	0.004	0.033-0.042
5	Significant Misalignment	0.5-0.6	0.021-0.018	0.013-0.011	0.014-0.012	0.005	0.043-0.053
6	Critical Misalignment	below0.5	Above 0.021	Above 0.013	Above 0.014	Above 0.005	Above 0.053

Appendix B5: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Fine grain level (Grade X); Subcategories)

Sr. No.	Level of Alignment	Alignment Index [AI]	Sum of Ratio Difference [RD] with respect to			
			Remember	**Understand**	**Skills**	**STS**
1	**Good Alignment**	0.9-1	0.076 & below	0.042 & below	0.042 & below	0.038 below
2	**Significant Alignment**	0.8-0.9	0.152-0.077	0.084-0.043	0.084-0.043	0.076-0.039
3	**Considerable Alignment**	0.7-0.8	0.228-0.153	0.126-0.085	0.126-0.085	0.114-0.077
4	**Considerable Misalignment**	0.6-0.7	0.304-0.229	0.168-0.127	0.168-0.127	0.152-0.115
5	**Significant Misalignment**	0.5-0.6	0.380-0.305	0.210-0.169	0.210-0.169	0.190-0.153
6	**Critical Misalignment**	below0.5	Above 0.380	Above 0.210	Above 0.210	Above 0.190

Appendix B6: Interpretation of Alignment Index [AI] and Ratio Difference [RD] Values (Fine grain level (Grade X); Topics Individually)

Sr. No.	Level of Alignment	Alignment Index [AI]	Ratio Difference [RD] with respect to				
			Remember	**Understand**	**Skills**	**STS**	**Total**
1	**Good Alignment**	0.9-1	0.004 & below	0.002 & below	0.002& below	0.002 & below	0.010 & below
2	**Significant Alignment**	0.8-0.9	0.007-0.005	0.004-0.003	0.004-0.003	0.004-0.003	0.019-0.011
3	**Considerable Alignment**	0.7-0.8	0.011-0.007	0.006-0.005	0.006-0.005	0.005	0.029-0.020
4	**Considerable Misalignment**	0.6-0.7	0.014-0.012	0.008-0.007	0.008-0.007	0.007	0.038-0.030
5	**Significant Misalignment**	0.5-0.6	0.018-0.015	0.010-0.009	0.010-0.009	0.009-0.008	0.048-0.039
6	**Critical Misalignment**	below0.5	Above 0.018	Above 0.010	Above 0.010	Above 0.009	Above 0.048

Appendix C

Surveys of Enacted Curriculum Protocol

Worthy Teacher,
Govt. Secondary/Higher Secondary School,
....

Respected Sir,

As I have already informed you that I, Abdul Jabbar Bhatti, am conducting a research entitled " Curriculum Audit: An Analysis of Curriculum Alignment at Secondary Level in Punjab". This research is part of my studies for the award of doctor in philosophy (Ph.D.) degree in education at the International Islamic University Islamabad. I must thank you for expressing willingness to cooperate in this research.

Once again, I assure you that data obtained from surveys will be confidential and the information will not be used other than the research purpose. Survey sheets contain no identifying information.

You are a competent Biology teacher at secondary level. I hope you will give your fair opinion on the attached sheet about what you taught in the Biology classes in your school.

Yours faithfully,

Abdul Jabbar Bhatti,
Reg. No: 68/FSS/PHDEDU/S11

Department of Education, Faculty of Social Sciences
IIU, ISLAMABAD
Contact No. 03006863425
E-mail: ajbinzoo@yahoo.com

For Class 9th

Name of Teacher (Optional):____________________

Qualifications: Academic ____________________professional______________

Numbers given in small boxes represent the percentage as under:

No.	Percentage	No.	Percentage	No.	Percentage	No.	Percentage
0	Nil	3	30	6	60	9	90
1	10	4	40	7	70	10	100
2	20	5	50	8	80		

Sr. No.	No. of Periods you devote for Topic(S)	Ch. No.	Topics	The Percentage of relative emphasis given to student learning outcome			
				Remember	Understand	Skills	STS Connections
1.		1	Biology	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
2.			Levels of Organization	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
3.		2	Biological Method	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
4.		3	1. Definition and Introduction of Biodiversity 2. Aims and Principles of Classification 3. History of Classification Systems 4. The Five Kingdoms 5. Binomial Nomenclature	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
5.			Conservation of biodiversity in Pakistan	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
6.		4	Microscopy and Emergence of Cell Theory	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
7.			Cellular Structures and Functions	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
8.			Active and Passive Transport of matter	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10

Sr. No.	No. of Periods you devote for Topic(S)	Ch. No.	Topics	The Percentage of relative emphasis given to student learning outcomes			
				Remember	Understand	Skills	STS Connections
9.			Tissues	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
10.		5	1. Cell Cycle and its phases 2. Mitosis	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
11.			1. Meiosis 2. Necrosis and Apoptosis	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
12.		6	1. Definition & Characteristics of Enzymes 2.Mechanism of Enzyme Action	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
13.			Specificity of Enzymes	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
14.		7	1. Introduction and the Role of ATP 2.Photosynthesis	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
15.			Respiration	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
16.		8	1. Nutrition in Plants 2. Nutrition in Man	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
17.			Digestion in Man & Disorders of Gut	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
18.		9	Transport in Plants	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
19.			Transport in Man	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10

For Class 10th

Sr. No.	No. of Periods you devote for Topic(S)	Ch. No.	Topics	The Percentage of relative emphasis given to student learning outcome			
				Remember	Understand	Skills	STS Connections
20.		10	Introduction to Gaseous Exchange 2. Gaseous Exchange in plants 3. Gaseous Exchange in Man	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
21.			Respiratory Disorders and their Causes	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
22.		11	Homeostasis in Plants & Man	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
23.			1. Urinary system of Man 2. Disorders of Human Excretory System	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
24.		12	1. Introduction and Types of Coordination 2. Human Nervous System	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
25.			Major Human Receptors	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
26.			1. Endocrine System 2. Nervous Disorders (Paralysis and Epilepsy)	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
27.		13	Human Skeleton	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
28.			1. Types of joints 2. Muscles and movement	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
29.			Disorders of Skeletal System (Arthritis and Osteoporosis)	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10

Sr. No.	No. of Periods you devote for Topic(S)	Ch. No.	Topics	The Percentage of relative emphasis given to student learning outcome			
				Remember	Understand	Skills	STS Connections
30.		14	1. Introduction to Reproduction 2. Asexual Reproduction in Plants	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
31.			Sexual Reproduction in Plants	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
32.			1. Asexual Reproduction in Animals 2. Sexual Reproduction in Animals	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
33.		15	1. Introduction to Inheritance 2. Chromosomes and Genes	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
34.			1. Mendal's Laws Variation and Evolution	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
35.		16	1. The Ecosystem: Levels of Ecological Organization; Components 2. Flow of materials and energy in the ecosystem 3.Biogeochemical Cycles (Carbon Cycle & Nitrogen Cycle)	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
36.			1. Interactions in the Ecosystem 2. Ecosystem Balance and Human impact on environment 3. Pollution, its Consequences and Control 4. Conservation of Nature	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10

Sr. No.	No. of Periods you devote for Topic(S)	Ch. No.	Topics	The Percentage of relative emphasis given to student learning outcome			
				Remember	**Understand**	**Skills**	**STS Connections**
37.		17	1. Introduction to Biotechnology 2.Fermentation	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
38.			1. Genetic Engineering 2. Single Cell Protein and its Uses	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
39.		18	1. Introduction to Pharmacology & Medicinal Drugs 2. Addictive Drugs	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10
40.			Antibiotics and Vaccines	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10	0 1 2 3 4 5 6 7 8 9 10

Appendix D

Content Analysis Protocol (Textbook)

For Class 9th

Sr. No.	No. of Periods for Topic(S)	Ch. No.	Topics	Number of student learning outcome			
				Remember	Understand	Skills	STS Connections
1.		1	Biology				
2.			Levels of Organization				
3.		2	Biological Method				
4.		3	1. Definition and Introduction of Biodiversity 2. Aims and Principles of Classification 3. History of Classification Systems 4. The Five Kingdoms 5. Binomial Nomenclature				
5.			Conservation of biodiversity in Pakistan				
6.		4	Microscopy and Emergence of Cell Theory				
7.			Cellular Structures and Functions				
8.			Active and Passive Transport of matter				
9.			Tissues				
10.		5	1. Cell Cycle and its phases 2. Mitosis				
11.			1. Meiosis 2. Necrosis and Apoptosis				
12.		6	1. Definition & Characteristics of Enzymes 2.Mechanism of Enzyme Action				
13.			Specificity of Enzymes				
14.		7	1. Introduction and the Role of ATP 2.Photosynthesis				
15.			Respiration				
16.		8	1. Nutrition in Plants 2. Nutrition in Man				
17.			Digestion in Man & Disorders of Gut				
18.		9	Transport in Plants				
19.			Transport in Man				

For Class 10^{th}

Sr. No.	No. of Periods for Topic(S)	Ch. No.	Topics	Number of student learning outcome			
				Remember	Understand	Skills	STS Connections
20.		10	1.Introduction to Gaseous Exchange 2. Gaseous Exchange in plants 3. Gaseous Exchange in Man				
21.			Respiratory Disorders and their Causes				
22.		11	Homeostasis in Plants & Man				
23.			1. Urinary system of Man 2. Disorders of Human Excretory System				
24.		12	Introduction & Types of Coordination 2. Human Nervous System				
25.			Major Human Receptors				
26.			1. Endocrine System 2. Nervous Disorders (Paralysis and Epilepsy)				
27.		13	Human Skeleton				
28.			1. Types of joints 2. Muscles and movement				
29.			Disorders of Skeletal System (Arthritis and Osteoporosis)				
30.		14	1. Introduction to Reproduction 2. Asexual Reproduction in Plants				
31.			Sexual Reproduction in Plants				
32.			1. Asexual Reproduction in Animals 2. Sexual Reproduction in Animals				
33.		15	1. Introduction to Inheritance 2. Chromosomes and Genes				
34.			1. Mendal's Laws 2. Variation and Evolution				
35.		16	1. The Ecosystem: Levels of Ecological Organization; Components 2. Flow of materials and energy in ecosystem 3.Biogeochemical Cycles (Carbon Cycle & Nitrogen Cycle)				
36.			1. Interactions in the Ecosystem 2. Ecosystem Balance and Human impact on environment 3. Pollution, its Consequences and Control 4. Conservation of Nature				
37.		17	1. Introduction to Biotechnology 2.Fermentation				
38.			1. Genetic Engineering 2. Single Cell Protein and its Uses				
39.		18	1. Introduction to Pharmacology & Medicinal Drugs 2. Addictive Drugs				
40.			Antibiotics and Vaccines				

Appendix E

Content Analysis Protocol (Papers)

For Class 9th

Sr. No.	Ch. No.	Topics	Number of student learning outcome			
			Remember	Understand	Skills	STS Connections
1.	1	Biology				
2.		Levels of Organization				
3.	2	Biological Method				
4.	3	1. Definition and Introduction of Biodiversity 2. Aims and Principles of Classification 3. History of Classification Systems 4. The Five Kingdoms 5. Binomial Nomenclature				
5.		Conservation of biodiversity in Pakistan				
6.	4	Microscopy and Emergence of Cell Theory				
7.		Cellular Structures and Functions				
8.		Active and Passive Transport of matter				
9.		Tissues				
10.	5	1. Cell Cycle and its phases 2. Mitosis				
11.		1. Meiosis 2. Necrosis and Apoptosis				
12.	6	1. Definition & Characteristics of Enzymes 2.Mechanism of Enzyme Action				
13.		Specificity of Enzymes				
14.	7	1. Introduction and the Role of ATP 2.Photosynthesis				
15.		Respiration				
16.	8	1. Nutrition in Plants 2. Nutrition in Man				
17.		Digestion in Man & Disorders of Gut				
18.	9	Transport in Plants				
19.		Transport in Man				

For Class 10th

Sr. No.	Ch. No.	Topics	Number of student learning outcome			
			Remember	Understand	Skills	STS Connections
20.	10	1.Introduction to Gaseous Exchange 2. Gaseous Exchange in plants 3. Gaseous Exchange in Man				
21.		Respiratory Disorders and their Causes				
22.	11	Homeostasis in Plants & Man				
23.		1. Urinary system of Man 2. Disorders of Human Excretory System				
24.	12	Introduction & Types of Coordination 2. Human Nervous System				
25.		Major Human Receptors				
26.		1. Endocrine System 2. Nervous Disorders (Paralysis and Epilepsy)				
27.	13	Human Skeleton				
28.		1. Types of joints 2. Muscles and movement				
29.		Disorders of Skeletal System (Arthritis and Osteoporosis)				
30.	14	1. Introduction to Reproduction 2. Asexual Reproduction in Plants				
31.		Sexual Reproduction in Plants				
32.		1. Asexual Reproduction in Animals 2. Sexual Reproduction in Animals				
33.	15	1. Introduction to Inheritance 2. Chromosomes and Genes				
34.		1. Mendal's Laws 2. Variation and Evolution				
35.	16	1. The Ecosystem: Levels of Ecological Organization; Components 2. Flow of materials and energy in ecosystem 3.Biogeochemical Cycles (Carbon Cycle & Nitrogen Cycle)				
36.		1. Interactions in the Ecosystem 2. Ecosystem Balance and Human impact on environment 3. Pollution, its Consequences and Control 4. Conservation of Nature				
37.	17	1. Introduction to Biotechnology 2.Fermentation				
38.		1. Genetic Engineering 2. Single Cell Protein and its Uses				
39.	18	1. Introduction to Pharmacology & Medicinal Drugs 2. Addictive Drugs				
40.		Antibiotics and Vaccines				

Appendix-F

OBSERVATION CHECK LIST FOR AVAILABILITY OF SUPPORTING MATERIALS

District ____________School ____________________ Date __________ Time ______

Sr. #	Item	Qnty.	Sr. #	Item	Qnty.	Sr. #	Item	Qnty.
1	Aquarium		16	Cotton Wool		35	Magnifying Glass	
2	Aquarium net		17	Differential air Thermometer		36	Measuring Cylinder	
3	Balance		18	Dissecting Board		37	Microscope (Compound)	
4	Beaker 10ml		19	Dissecting Box		38	Microscope (Dissecting)	
5	50ml		20	Dissecting Tray		39	Microscope Cover	
	100ml		21	Dropper		40	Microscope Slide	
	250ml		22	Funnel 4"		41	Petri Dish	
	500ml		23	Funnel 6"		42	Pipette	
	1000ml		24	Glass Tube		43	Plant Presser	
6	Bell jar		25	Incubator		44	Plate (Glass)	
7	Blades(Safety razor)		26	Inoculation Loop		45	Potometer	
8	Burner(Bunsen)		27	Insect Net		46	Slide projectors	
9	Burner(Spirit Lamp)		28	Lens Paper		47	Charts	
10	Conical Flask		29	Light Source		48	Stuffed animals	
11	Reagent Bottles		30	Syringe		49	Projector	
12	Specimen Jars		31	Test Tube Rack		50	Preserved Specimens of animals	
13	Stop Watch		32	Thermometer				
14	Stopper (Cork)		33	Thermos Flask		51		
15	Tripod Stand		34	Watch Glass		52		

Continued to Page 2

Chemicals

Sr. #	Item	Qnty.	Sr. #	Item	Qnty.	Sr. #	Item	Qnty.
1	Acetic acid		9	Distilled water		17	Lime water	
2	Copper sulfate solution		10	Hydrogen carbonate indicator		18	Methylene Potassium hydroxide blue 01%	
3	Ascorbic acid		11	Ethanol		19	Starch	
4	Benedict's solution		12	Formaline		20	Sudan III solution	
5	Bromothymol blue solution		13	Glucose solution 01%		21	Trypsin 2	
6	Chloroform		14	Glycerine		22	Wax	
7	Alcohol		15	Eosine		23		
8	Diastase		16	Iodine solution 01%		24		

Prepared Slides

Sr. #	Item	Qnty.	Sr. #	Item	Qnty.	Sr. #	Item	Qnty.
1	Bacteria		8	Mitosis		15	Meiosis	
2	Cells of onion epidermis		9	Transverse Section of Capillary		16	T.S. of Human Small Intestine	
3	*Hydrilla* Leaf		10	Mushroom		17	Sections of animal tissues	
4	T.S. of Woody stem		11	T.S. of Mammalian Air sacs		18	Section of Mammalian kidney	
5	T.S. of Stem		12	Conjugation in *Paramecium*		19	T.S. of Artery,	
6	Rhizopus		13	T.S. of Root		20	T.S. of Leaf	
7	T.S. of Vein		14	Nerve Cell		21		

Appendix-G

SLO RATIOS

Appendix G1. SLO Ratios in Written Curriculum (Coarse Grain Level)

Sections	Remember1	Understand1	Skills1	STS1
A	0.049	0.041	0.051	0.026
B	0.065	0.043	0.048	0.011
C	0.070	0.032	0.040	0.024
D	0.057	0.037	0.039	0.034
E	0.049	0.054	0.029	0.034
F	0.100	0.029	0.008	0.029
Subtotal	0.390	0.236	0.216	0.158
Total				**1.000**

Appendix G2. Written Curriculum-Grade IX SLOs in Ratios (Fine Grain Level)

Topics	Remember1	Understand1	Skills1	STS1
1a	0.018	0.023	0.000	0.012
1b	0.020	0.013	0.020	0.000
2a	0.004	0.012	0.036	0.000
3a	0.019	0.011	0.011	0.013
3b	0.016	0.011	0.016	0.011
4a	0.011	0.016	0.011	0.016
4b	0.006	0.023	0.023	0.000
4c	0.019	0.005	0.024	0.005
4d	0.014	0.010	0.014	0.014
5a	0.032	0.007	0.014	0.000
5b	0.023	0.019	0.008	0.004
6a	0.030	0.011	0.011	0.000
6b	0.011	0.021	0.021	0.000
7a	0.028	0.009	0.015	0.000
7b	0.023	0.018	0.012	0.000
8a	0.022	0.015	0.009	0.007
8b	0.039	0.004	0.004	0.004
9a	0.017	0.017	0.019	0.000
9b	0.034	0.004	0.008	0.006
Subtotal	**0.384**	**0.249**	**0.276**	**0.091**
Total				**1.000**

Appendix G3. Written Curriculum-Grade X SLOs in Ratios (Fine Grain Level)

Topics	**Remember1**	**Understand1**	**Skills1**	**STS1**
10a	0.012	0.006	0.027	0.003
10b	0.011	0.000	0.011	0.026
11a	0.024	0.018	0.006	0.000
11b	0.022	0.006	0.013	0.006
12a	0.016	0.011	0.014	0.007
12b	0.012	0.012	0.012	0.012
12c	0.013	0.013	0.004	0.017
13a	0.024	0.006	0.012	0.006
13b	0.026	0.005	0.011	0.005
13c	0.012	0.024	0.000	0.012
14a	0.016	0.012	0.008	0.012
14b	0.022	0.004	0.022	0.000
14c	0.017	0.013	0.009	0.009
15a	0.018	0.007	0.004	0.018
15b	0.013	0.013	0.013	0.009
16a	0.024	0.014	0.007	0.003
16b	0.007	0.017	0.010	0.014
17a	0.024	0.014	0.010	0.000
17b	0.032	0.000	0.000	0.016
18a	0.040	0.004	0.000	0.004
18b	0.008	0.024	0.000	0.016
Subtotal	**0.391**	**0.223**	**0.189**	**0.197**
Total				**1.000**

Appendix G4. SLO Ratios in Textbook (Coarse Grain Level)

Sections	Remember2	Understand2	Skills2	STS2
A	0.111	0.028	0.028	0.000
B	0.099	0.024	0.044	0.000
C	0.098	0.030	0.038	0.000
D	0.080	0.042	0.045	0.000
E	0.105	0.025	0.037	0.000
F	0.152	0.005	0.010	0.000
Subtotal	**0.645**	**0.153**	**0.202**	**0.000**
Total				**1.000**

Appendix G5. Textbook-Grade IX SLOs in Ratios (Fine Grain Level)

Topics	Remember2	Understand2	Skills2	STS2
1a	0.038	0.015	0.000	0.000
1b	0.030	0.008	0.015	0.000
2a	0.039	0.013	0.000	0.000
3a	0.040	0.003	0.009	0.000
3b	0.023	0.015	0.015	0.000
4a	0.035	0.009	0.009	0.000
4b	0.023	0.007	0.023	0.000
4c	0.038	0.000	0.015	0.000
4d	0.030	0.008	0.015	0.000
5a	0.039	0.000	0.014	0.000
5b	0.032	0.012	0.008	0.000
6a	0.032	0.008	0.012	0.000
6b	0.032	0.000	0.021	0.000
7a	0.032	0.011	0.011	0.000
7b	0.023	0.018	0.012	0.000
8a	0.033	0.014	0.006	0.000
8b	0.033	0.014	0.005	0.000
9a	0.030	0.003	0.019	0.000
9b	0.038	0.007	0.007	0.000
Subtotal	**0.621**	**0.163**	**0.216**	**0.000**
Total				**1.000**

Appendix G6. Textbook-Grade X SLOs in Ratios (Fine Grain Level)

Topics	**Remember2**	**Understand2**	**Skills2**	**STS2**
10a	0.017	0.003	0.027	0.000
10b	0.048	0.000	0.000	0.000
11a	0.034	0.014	0.000	0.000
11b	0.031	0.006	0.011	0.000
12a	0.024	0.012	0.012	0.000
12b	0.016	0.016	0.016	0.000
12c	0.027	0.014	0.007	0.000
13a	0.027	0.007	0.014	0.000
13b	0.030	0.006	0.012	0.000
13c	0.032	0.016	0.000	0.000
14a	0.000	0.037	0.011	0.000
14b	0.026	0.000	0.022	0.000
14c	0.037	0.000	0.011	0.000
15a	0.041	0.007	0.000	0.000
15b	0.019	0.014	0.014	0.000
16a	0.033	0.007	0.007	0.000
16b	0.027	0.007	0.014	0.000
17a	0.038	0.000	0.010	0.000
17b	0.048	0.000	0.000	0.000
18a	0.048	0.000	0.000	0.000
18b	0.036	0.012	0.000	0.000
Subtotal	**0.637**	**0.177**	**0.186**	**0.000**
Total				**1.000**

Appendix G7. Coarse Grain level SLO Ratios in Question Papers by BISE (L)

Sections	**Remember1**	**Understand1**	**Skills1**	**STS1**
A	0.085	0.034	0.048	0.000
B	0.114	0.028	0.025	0.000
C	0.119	0.015	0.032	0.000
D	0.085	0.021	0.060	0.000
E	0.142	0.025	0.000	0.000
F	0.142	0.017	0.008	0.000
Subtotal	0.687	0.140	0.174	0.000
Total				**1.000**

Appendix G8. Coarse Grain level SLO Ratios in Question Papers by BISE (M)

Sections	Remember2	Understand2	Skills2	STS2
A	0.074	0.030	0.063	0.000
B	0.124	0.021	0.021	0.000
C	0.104	0.031	0.032	0.000
D	0.095	0.024	0.048	0.000
E	0.133	0.033	0.000	0.000
F	0.103	0.044	0.020	0.000
Subtotal	0.633	0.183	0.183	0.000
Total				**1.000**

Appendix G9. Coarse Grain level SLO Ratios in Question Papers by BISE (N)

Sections	Remember2	Understand2	Skills2	STS2
A	0.103	0.034	0.029	0.000
B	0.101	0.038	0.028	0.000
C	0.113	0.012	0.041	0.000
D	0.066	0.055	0.046	0.000
E	0.095	0.042	0.030	0.000
F	0.142	0.025	0.000	0.000
Subtotal	0.621	0.206	0.173	0.000
Total				**1.000**

Appendix G10. Coarse Grain level SLO Ratios in Curriculum Taught by Group W1

Sections	Remember1	Understand1	Skills1	STS1
A	0.104	0.032	0.027	0.004
B	0.106	0.027	0.028	0.006
C	0.097	0.025	0.041	0.004
D	0.095	0.027	0.041	0.004
E	0.113	0.027	0.020	0.008
F	0.123	0.018	0.021	0.005
Subtotal	**0.637**	**0.156**	**0.177**	**0.030**
Total				**1.000**

Appendix G11. Coarse Grain level SLO Ratios in Curriculum Taught by Group W2

Sections	Remember2	Understand2	Skills2	STS2
A	0.119	0.029	0.017	0.002
B	0.113	0.038	0.013	0.003
C	0.117	0.024	0.023	0.003
D	0.098	0.025	0.041	0.003
E	0.123	0.025	0.014	0.005
F	0.113	0.032	0.019	0.003
Subtotal	**0.682**	**0.172**	**0.126**	**0.020**
Total				**1.000**

Appendix G12. Coarse Grain level SLO Ratios in Curriculum Taught by Group W3

Sections	Remember2	Understand2	Skills2	STS2
A	0.141	0.021	0.003	0.001
B	0.133	0.023	0.009	0.002
C	0.132	0.013	0.020	0.002
D	0.122	0.023	0.019	0.002
E	0.131	0.027	0.008	0.002
F	0.142	0.019	0.005	0.001
Subtotal	0.801	0.127	0.062	0.010
Total				**1.000**

Appendix G13. Coarse Grain level SLO Ratios in Curriculum Taught by Group W4

Sections	Remember2	Understand2	Skills2	STS2
A	0.066	0.051	0.029	0.020
B	0.078	0.045	0.034	0.011
C	0.087	0.034	0.031	0.016
D	0.076	0.030	0.038	0.022
E	0.093	0.039	0.018	0.017
F	0.107	0.040	0.003	0.016
Subtotal	0.507	0.239	0.153	0.101
Total				**1.000**

Appendix G14. Coarse Grain level SLO Ratios in Curriculum Taught by Group X1

Sections	Remember1	Understand1	Skills1	STS1
A	0.103	0.027	0.031	0.006
B	0.111	0.019	0.034	0.004
C	0.112	0.020	0.029	0.005
D	0.106	0.020	0.036	0.005
E	0.105	0.026	0.028	0.008
F	0.133	0.018	0.011	0.005
Subtotal	**0.670**	**0.130**	**0.168**	**0.033**
Total				**1.000**

Appendix G15. Coarse Grain level SLO Ratios in Curriculum Taught by Group X2

Sections	Remember2	Understand2	Skills2	STS2
A	0.124	0.026	0.013	0.004
B	0.125	0.029	0.011	0.002
C	0.122	0.019	0.022	0.004
D	0.110	0.020	0.032	0.005
E	0.126	0.026	0.014	0.001
F	0.129	0.018	0.015	0.005
Subtotal	0.736	0.137	0.107	0.020
Total				**1.000**

Appendix G16. Coarse Grain level SLO Ratios in Curriculum Taught by Group X3

Sections	Remember2	Understand2	Skills2	STS2
A	0.142	0.016	0.006	0.002
B	0.140	0.017	0.009	0.001
C	0.135	0.012	0.016	0.003
D	0.134	0.016	0.015	0.002
E	0.139	0.018	0.007	0.003
F	0.150	0.013	0.003	0.001
Subtotal	0.839	0.093	0.056	0.012
Total				1.000

Appendix G17. Coarse Grain level SLO Ratios in Curriculum Taught by Group X4

Sections	Remember2	Understand2	Skills2	STS2
A	0.080	0.040	0.030	0.016
B	0.097	0.033	0.028	0.008
C	0.105	0.024	0.026	0.012
D	0.103	0.022	0.026	0.015
E	0.102	0.031	0.019	0.015
F	0.126	0.023	0.005	0.013
Subtotal	0.611	0.173	0.135	0.081
Total				1.000

Appendix G18. Coarse Grain level SLO Ratios in Curriculum Taught by Group Y1

Sections	Remember1	Understand1	Skills1	STS1
A	0.123	0.023	0.016	0.004
B	0.124	0.017	0.021	0.005
C	0.119	0.020	0.023	0.005
D	0.116	0.022	0.023	0.006
E	0.118	0.023	0.020	0.007
F	0.132	0.021	0.009	0.005
Subtotal	0.731	0.125	0.112	0.032
Total				1.000

Appendix G19. Coarse Grain level SLO Ratios in Curriculum Taught by Group Y2

Sections	Remember2	Understand2	Skills2	STS2
A	0.132	0.017	0.012	0.005
B	0.131	0.018	0.013	0.005
C	0.126	0.020	0.018	0.003
D	0.119	0.020	0.024	0.003
E	0.123	0.025	0.014	0.005
F	0.113	0.032	0.019	0.003
Subtotal	0.744	0.132	0.101	0.024
Total				1.000

Appendix G20. Coarse Grain level SLO Ratios in Curriculum Taught by Group Y3

Sections	Remember2	Understand2	Skills2	STS2
A	0.130	0.017	0.009	0.011
B	0.131	0.011	0.015	0.011
C	0.136	0.011	0.016	0.003
D	0.126	0.016	0.020	0.005
E	0.136	0.021	0.007	0.003
F	0.137	0.019	0.007	0.004
Subtotal	0.795	0.095	0.073	0.038
Total				1.000

Appendix G21. Coarse Grain level SLO Ratios in Curriculum Taught by Group Y4

Sections	Remember2	Understand2	Skills2	STS2
A	0.079	0.038	0.033	0.017
B	0.091	0.033	0.027	0.016
C	0.099	0.026	0.027	0.014
D	0.099	0.025	0.026	0.017
E	0.094	0.038	0.022	0.013
F	0.106	0.032	0.006	0.023
Subtotal	0.567	0.191	0.141	0.101
Total				1.000

Appendix G22. Coarse Grain level SLO Ratios in Curriculum Taught by Group Z1

Sections	Remember1	Understand1	Skills1	STS1
A	0.104	0.019	0.027	0.016
B	0.107	0.018	0.030	0.013
C	0.110	0.019	0.026	0.011
D	0.110	0.019	0.025	0.012
E	0.114	0.020	0.023	0.009
F	0.103	0.017	0.026	0.021
Subtotal	0.649	0.112	0.157	0.082
Total				1.000

Appendix G23. Coarse Grain level SLO Ratios in Curriculum Taught by Group Z2

Sections	Remember2	Understand2	Skills2	STS2
A	0.117	0.018	0.015	0.017
B	0.113	0.017	0.017	0.020
C	0.122	0.017	0.021	0.006
D	0.132	0.013	0.017	0.005
E	0.127	0.017	0.017	0.007
F	0.104	0.028	0.026	0.009
Subtotal	0.714	0.110	0.112	0.064
Total				1.000

Appendix G24. Coarse Grain level SLO Ratios in Curriculum Taught by Group Z3

Sections	**Remember2**	**Understand2**	**Skills2**	**STS2**
A	0.123	0.015	0.016	0.013
B	0.127	0.013	0.013	0.015
C	0.130	0.012	0.016	0.009
D	0.129	0.011	0.015	0.013
E	0.136	0.009	0.014	0.008
F	0.127	0.011	0.018	0.011
Subtotal	0.772	0.070	0.091	0.068
Total				**1.000**

Appendix G25. Coarse Grain level SLO Ratios in Curriculum Taught by Group Z4

Sections	**Remember2**	**Understand2**	**Skills2**	**STS2**
A	0.089	0.039	0.026	0.013
B	0.098	0.031	0.027	0.011
C	0.098	0.026	0.026	0.016
D	0.090	0.026	0.030	0.021
E	0.098	0.029	0.019	0.020
F	0.112	0.035	0.005	0.015
Subtotal	0.585	0.186	0.132	0.097
Total				**1.000**

Appendix G26. Fine Grain level SLO Ratios in Question Papers (Grade-IX) by BISE (L)

Topics	Remember4	Understand4	Skills4	STS4
1a	0.025	0.028	0.000	0.000
1b	0.018	0.006	0.029	0.000
2a	0.022	0.009	0.022	0.000
3a	0.053	0.000	0.000	0.000
3b	0.000	0.000	0.000	0.000
4a	0.011	0.042	0.000	0.000
4b	0.037	0.016	0.000	0.000
4c	0.013	0.039	0.000	0.000
4d	0.053	0.000	0.000	0.000
5a	0.048	0.004	0.000	0.000
5b	0.053	0.000	0.000	0.000
6a	0.036	0.006	0.010	0.000
6b	0.000	0.000	0.000	0.000
7a	0.033	0.000	0.020	0.000
7b	0.032	0.000	0.021	0.000
8a	0.049	0.000	0.004	0.000
8b	0.009	0.000	0.044	0.000
9a	0.042	0.000	0.011	0.000
9b	0.053	0.000	0.000	0.000
Subtotal	**0.584**	**0.151**	**0.160**	**0.000**
Total				**1.000**

Appendix G27. Fine Grain level SLO Ratios in Question Papers (Grade-IX) by BISE (M)

Topics	Remember4	Understand4	Skills4	STS4
1a	0.039	0.014	0.000	0.000
1b	0.019	0.010	0.024	0.000
2a	0.032	0.021	0.000	0.000
3a	0.013	0.005	0.035	0.000
3b	0.053	0.000	0.000	0.000
4a	0.053	0.000	0.000	0.000
4b	0.037	0.000	0.016	0.000
4c	0.032	0.020	0.000	0.000
4d	0.053	0.000	0.000	0.000
5a	0.053	0.000	0.000	0.000
5b	0.024	0.029	0.000	0.000
6a	0.041	0.000	0.012	0.000
6b	0.053	0.000	0.000	0.000
7a	0.039	0.000	0.013	0.000
7b	0.000	0.053	0.000	0.000
8a	0.038	0.000	0.015	0.000
8b	0.046	0.006	0.000	0.000
9a	0.033	0.000	0.020	0.000
9b	0.043	0.010	0.000	0.000
Subtotal	**0.698**	**0.167**	**0.134**	**0.000**
Total				**1.000**

Appendix G28. Fine Grain level SLO Ratios in Question Papers for Grade-IX by BISE (N)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
1a	0.047	0.005	0.000	0.000
1b	0.029	0.023	0.000	0.000
2a	0.038	0.000	0.015	0.000
3a	0.021	0.018	0.013	0.000
3b	0.053	0.000	0.000	0.000
4a	0.053	0.000	0.000	0.000
4b	0.039	0.013	0.000	0.000
4c	0.039	0.013	0.000	0.000
4d	0.021	0.032	0.000	0.000
5a	0.026	0.026	0.000	0.000
5b	0.026	0.026	0.000	0.000
6a	0.043	0.000	0.009	0.000
6b	0.053	0.000	0.000	0.000
7a	0.024	0.005	0.024	0.000
7b	0.019	0.014	0.019	0.000
8a	0.029	0.002	0.023	0.000
8b	0.043	0.000	0.009	0.000
9a	0.038	0.000	0.015	0.000
9b	0.046	0.007	0.000	0.000
Subtotal	**0.688**	**0.185**	**0.127**	**0.000**
Total				**1.000**

Appendix G29. Fine Grain level SLO Ratios in Question Papers for Grade X by BISE (L)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.022	0.013	0.013	0.000
10b	0.014	0.014	0.019	0.000
11a	0.009	0.009	0.030	0.000
11b	0.048	0.000	0.000	0.000
12a	0.048	0.000	0.000	0.000
12b	0.048	0.000	0.000	0.000
12c	0.048	0.000	0.000	0.000
13a	0.041	0.007	0.000	0.000
13b	0.029	0.019	0.000	0.000
13c	0.048	0.000	0.000	0.000
14a	0.017	0.005	0.026	0.000
14b	0.000	0.000	0.048	0.000
14c	0.038	0.000	0.010	0.000
15a	0.048	0.000	0.000	0.000
15b	0.027	0.021	0.000	0.000
16a	0.040	0.008	0.000	0.000
16b	0.042	0.006	0.000	0.000
17a	0.048	0.000	0.000	0.000
17b	0.041	0.000	0.007	0.000
18a	0.048	0.000	0.000	0.000
18b	0.029	0.019	0.000	0.000
Subtotal	**0.728**	**0.120**	**0.152**	**0.000**
Total				**1.000**

Appendix G30. Fine Grain level SLO Ratios in Question Papers for Grade X by BISE (M)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.015	0.026	0.006	0.000
10b	0.029	0.000	0.019	0.000
11a	0.011	0.011	0.026	0.000
11b	0.028	0.006	0.014	0.000
12a	0.041	0.006	0.000	0.000
12b	0.048	0.000	0.000	0.000
12c	0.048	0.000	0.000	0.000
13a	0.022	0.010	0.016	0.000
13b	0.008	0.040	0.000	0.000
13c	0.048	0.000	0.000	0.000
14a	0.014	0.012	0.021	0.000
14b	0.048	0.000	0.000	0.000
14c	0.017	0.003	0.028	0.000
15a	0.038	0.010	0.000	0.000
15b	0.044	0.003	0.000	0.000
16a	0.026	0.021	0.000	0.000
16b	0.048	0.000	0.000	0.000
17a	0.021	0.012	0.015	0.000
17b	0.048	0.000	0.000	0.000
18a	0.022	0.026	0.000	0.000
18b	0.048	0.000	0.000	0.000
Subtotal	**0.670**	**0.185**	**0.145**	**0.000**
Total				**1.000**

Appendix G31. Fine Grain level SLO Ratios in Question Papers for Grade X by BISE (N)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.023	0.004	0.021	0.000
10b	0.048	0.000	0.000	0.000
11a	0.048	0.000	0.000	0.000
11b	0.048	0.000	0.000	0.000
12a	0.036	0.012	0.000	0.000
12b	0.048	0.000	0.000	0.000
12c	0.048	0.000	0.000	0.000
13a	0.010	0.008	0.030	0.000
13b	0.038	0.010	0.000	0.000
13c	0.048	0.000	0.000	0.000
14a	0.016	0.019	0.013	0.000
14b	0.013	0.006	0.028	0.000
14c	0.016	0.021	0.011	0.000
15a	0.040	0.007	0.000	0.000
15b	0.013	0.035	0.000	0.000
16a	0.018	0.011	0.018	0.000
16b	0.035	0.013	0.000	0.000
17a	0.048	0.000	0.000	0.000
17b	0.029	0.019	0.000	0.000
18a	0.033	0.014	0.000	0.000
18b	0.048	0.000	0.000	0.000
Subtotal	0.701	0.179	0.121	0.000
Total				**1.000**

Appendix G32. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W1, Grade-IX)

Topics	**Remember3**	**Understand3**	**Skills3**	**STS3**
1a	0.039	0.012	0.000	0.002
1b	0.031	0.006	0.015	0.001
2a	0.033	0.009	0.008	0.003
3a	0.031	0.008	0.014	0.000
3b	0.031	0.016	0.006	0.000
4a	0.037	0.009	0.006	0.001
4b	0.041	0.004	0.006	0.001
4c	0.025	0.020	0.007	0.001
4d	0.029	0.010	0.013	0.001
5a	0.036	0.009	0.007	0.001
5b	0.026	0.009	0.017	0.001
6a	0.041	0.005	0.006	0.001
6b	0.036	0.003	0.012	0.001
7a	0.025	0.009	0.007	0.012
7b	0.039	0.006	0.007	0.001
8a	0.030	0.006	0.016	0.001
8b	0.029	0.006	0.016	0.001
9a	0.035	0.011	0.006	0.001
9b	0.032	0.014	0.005	0.002
Subtotal	**0.625**	**0.172**	**0.172**	**0.031**
Total				**1.000**

Appendix G33. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W2, Grade-IX)

Topics	**Remember3**	**Understand3**	**Skills3**	**STS3**
1a	0.042	0.011	0.000	0.000
1b	0.024	0.007	0.021	0.001
2a	0.033	0.012	0.006	0.003
3a	0.047	0.006	0.000	0.000
3b	0.043	0.010	0.000	0.000
4a	0.023	0.024	0.005	0.001
4b	0.032	0.020	0.000	0.001
4c	0.038	0.008	0.005	0.001
4d	0.044	0.008	0.000	0.000
5a	0.042	0.009	0.002	0.000
5b	0.037	0.012	0.002	0.001
6a	0.036	0.014	0.003	0.000
6b	0.037	0.008	0.006	0.001
7a	0.028	0.009	0.012	0.003
7b	0.039	0.005	0.006	0.002
8a	0.038	0.003	0.010	0.001
8b	0.035	0.009	0.007	0.001
9a	0.043	0.005	0.004	0.001
9b	0.037	0.010	0.005	0.000
Subtotal	**0.698**	**0.192**	**0.092**	**0.017**
Total				**1.000**

Appendix G34. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W3, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.039	0.011	0.000	0.002
1b	0.043	0.007	0.003	0.000
2a	0.046	0.005	0.002	0.000
3a	0.046	0.006	0.000	0.000
3b	0.048	0.005	0.000	0.000
4a	0.039	0.009	0.004	0.000
4b	0.044	0.006	0.002	0.000
4c	0.036	0.007	0.007	0.002
4d	0.048	0.005	0.000	0.000
5a	0.047	0.006	0.000	0.000
5b	0.048	0.004	0.000	0.000
6a	0.036	0.014	0.003	0.000
6b	0.038	0.008	0.006	0.001
7a	0.039	0.010	0.002	0.002
7b	0.044	0.005	0.003	0.001
8a	0.044	0.003	0.005	0.001
8b	0.045	0.004	0.003	0.001
9a	0.041	0.005	0.006	0.001
9b	0.044	0.004	0.004	0.001
Subtotal	**0.817**	**0.124**	**0.049**	**0.010**
Total				**1.000**

Appendix G35. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W4, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.023	0.017	0.000	0.013
1b	0.026	0.016	0.011	0.000
2a	0.013	0.019	0.021	0.000
3a	0.025	0.017	0.005	0.006
3b	0.018	0.011	0.010	0.013
4a	0.012	0.022	0.016	0.003
4b	0.022	0.016	0.015	0.000
4c	0.021	0.007	0.019	0.006
4d	0.017	0.018	0.011	0.007
5a	0.039	0.006	0.008	0.000
5b	0.027	0.020	0.005	0.001
6a	0.036	0.009	0.007	0.000
6b	0.019	0.015	0.012	0.007
7a	0.025	0.013	0.009	0.006
7b	0.028	0.015	0.006	0.003
8a	0.026	0.013	0.011	0.003
8b	0.033	0.010	0.006	0.003
9a	0.025	0.013	0.009	0.005
9b	0.037	0.006	0.006	0.003
Subtotal	**0.471**	**0.264**	**0.186**	**0.079**
Total				**1.000**

Appendix G36. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X1, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.031	0.012	0.004	0.005
1b	0.035	0.008	0.008	0.001
2a	0.028	0.008	0.016	0.000
3a	0.033	0.008	0.010	0.001
3b	0.035	0.006	0.010	0.002
4a	0.038	0.009	0.006	0.000
4b	0.033	0.004	0.014	0.001
4c	0.031	0.007	0.015	0.000
4d	0.034	0.006	0.011	0.003
5a	0.041	0.005	0.007	0.000
5b	0.032	0.007	0.011	0.002
6a	0.036	0.005	0.011	0.001
6b	0.031	0.006	0.014	0.002
7a	0.038	0.006	0.008	0.001
7b	0.036	0.004	0.010	0.003
8a	0.041	0.006	0.006	0.000
8b	0.037	0.004	0.010	0.001
9a	0.042	0.007	0.003	0.001
9b	0.038	0.004	0.008	0.003
Subtotal	**0.669**	**0.123**	**0.182**	**0.025**
Total				**1.000**

Appendix G37. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X2, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.039	0.013	0.000	0.001
1b	0.034	0.006	0.012	0.001
2a	0.037	0.008	0.005	0.002
3a	0.044	0.005	0.003	0.001
3b	0.042	0.009	0.000	0.002
4a	0.037	0.011	0.004	0.001
4b	0.039	0.013	0.000	0.001
4c	0.036	0.010	0.004	0.002
4d	0.046	0.007	0.000	0.000
5a	0.043	0.008	0.002	0.000
5b	0.039	0.010	0.002	0.001
6a	0.041	0.007	0.004	0.000
6b	0.038	0.007	0.006	0.002
7a	0.036	0.009	0.008	0.000
7b	0.038	0.008	0.005	0.002
8a	0.036	0.006	0.010	0.001
8b	0.040	0.007	0.004	0.002
9a	0.033	0.005	0.014	0.001
9b	0.039	0.012	0.002	0.000
Subtotal	**0.737**	**0.160**	**0.085**	**0.018**
Total				**1.000**

Appendix G38. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X3, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.044	0.007	0.000	0.002
1b	0.044	0.005	0.004	0.001
2a	0.045	0.004	0.003	0.001
3a	0.045	0.004	0.003	0.001
3b	0.047	0.006	0.000	0.000
4a	0.044	0.005	0.004	0.000
4b	0.045	0.005	0.002	0.000
4c	0.043	0.003	0.006	0.001
4d	0.047	0.005	0.001	0.000
5a	0.048	0.004	0.000	0.000
5b	0.046	0.006	0.001	0.000
6a	0.042	0.008	0.003	0.000
6b	0.043	0.005	0.004	0.001
7a	0.042	0.008	0.003	0.001
7b	0.042	0.006	0.004	0.001
8a	0.044	0.003	0.004	0.002
8b	0.042	0.005	0.005	0.001
9a	0.041	0.006	0.005	0.002
9b	0.045	0.004	0.003	0.001
Subtotal	**0.837**	**0.097**	**0.054**	**0.012**
Total				**1.000**

Appendix G39. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X4 Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.024	0.018	0.000	0.011
1b	0.026	0.014	0.012	0.000
2a	0.022	0.012	0.019	0.000
3a	0.028	0.010	0.009	0.006
3b	0.027	0.009	0.007	0.009
4a	0.023	0.015	0.008	0.006
4b	0.027	0.013	0.011	0.001
4c	0.029	0.009	0.011	0.003
4d	0.031	0.008	0.008	0.005
5a	0.038	0.006	0.007	0.002
5b	0.031	0.014	0.005	0.003
6a	0.035	0.009	0.006	0.002
6b	0.026	0.012	0.012	0.003
7a	0.032	0.007	0.010	0.003
7b	0.030	0.012	0.009	0.002
8a	0.032	0.010	0.007	0.004
8b	0.044	0.003	0.003	0.003
9a	0.034	0.009	0.008	0.001
9b	0.043	0.002	0.005	0.002
Subtotal	**0.582**	**0.193**	**0.160**	**0.065**
Total				**1.000**

Appendix G40. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y1 Grade-IX)

Topics	**Remember3**	**Understand3**	**Skills3**	**STS3**
1a	0.037	0.013	0.000	0.002
1b	0.041	0.006	0.004	0.002
2a	0.039	0.006	0.005	0.002
3a	0.038	0.007	0.007	0.000
3b	0.039	0.004	0.008	0.001
4a	0.042	0.005	0.005	0.001
4b	0.038	0.005	0.007	0.002
4c	0.037	0.003	0.009	0.003
4d	0.042	0.005	0.006	0.000
5a	0.040	0.004	0.007	0.002
5b	0.038	0.007	0.006	0.001
6a	0.041	0.006	0.005	0.001
6b	0.035	0.008	0.007	0.002
7a	0.037	0.005	0.008	0.003
7b	0.042	0.004	0.006	0.002
8a	0.037	0.005	0.007	0.003
8b	0.039	0.005	0.006	0.002
9a	0.041	0.005	0.004	0.002
9b	0.038	0.008	0.005	0.001
Subtotal	0.741	0.113	0.115	0.031
Total				**1.000**

Appendix G41. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y2, Grade-IX)

Topics	**Remember3**	**Understand3**	**Skills3**	**STS3**
1a	0.043	0.008	0.000	0.001
1b	0.033	0.006	0.012	0.002
2a	0.043	0.004	0.003	0.003
3a	0.043	0.005	0.003	0.002
3b	0.047	0.004	0.002	0.001
4a	0.040	0.008	0.004	0.001
4b	0.042	0.006	0.003	0.002
4c	0.043	0.005	0.004	0.001
4d	0.046	0.003	0.003	0.001
5a	0.042	0.007	0.002	0.002
5b	0.041	0.005	0.005	0.002
6a	0.041	0.007	0.004	0.001
6b	0.042	0.005	0.005	0.001
7a	0.035	0.008	0.007	0.003
7b	0.043	0.003	0.005	0.002
8a	0.039	0.006	0.006	0.001
8b	0.037	0.007	0.007	0.001
9a	0.040	0.007	0.005	0.001
9b	0.038	0.009	0.005	0.000
Subtotal	**0.776**	**0.115**	**0.084**	**0.025**
Total				**1.000**

Appendix G42. Fine Grain level SLO Ratios in Curriculum Taught by Group-Y3 (Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.045	0.007	0.000	0.001
1b	0.038	0.006	0.004	0.004
2a	0.041	0.004	0.004	0.003
3a	0.038	0.005	0.003	0.006
3b	0.043	0.005	0.002	0.003
4a	0.041	0.005	0.003	0.003
4b	0.041	0.004	0.005	0.003
4c	0.041	0.002	0.005	0.005
4d	0.044	0.002	0.006	0.001
5a	0.039	0.004	0.006	0.004
5b	0.044	0.002	0.005	0.002
6a	0.040	0.004	0.004	0.005
6b	0.038	0.004	0.006	0.005
7a	0.041	0.003	0.004	0.004
7b	0.043	0.003	0.003	0.003
8a	0.043	0.005	0.004	0.001
8b	0.044	0.005	0.003	0.001
9a	0.041	0.003	0.005	0.004
9b	0.046	0.003	0.002	0.001
Subtotal	**0.791**	**0.075**	**0.075**	**0.059**
Total				**1.000**

Appendix G43. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y4, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.045	0.007	0.000	0.001
1b	0.038	0.006	0.004	0.004
2a	0.041	0.004	0.004	0.003
3a	0.043	0.005	0.003	0.002
3b	0.045	0.003	0.002	0.003
4a	0.041	0.005	0.003	0.003
4b	0.041	0.004	0.005	0.003
4c	0.048	0.002	0.003	0.000
4d	0.044	0.002	0.000	0.007
5a	0.039	0.004	0.000	0.009
5b	0.044	0.002	0.005	0.002
6a	0.042	0.000	0.000	0.011
6b	0.038	0.004	0.002	0.009
7a	0.041	0.003	0.004	0.004
7b	0.043	0.003	0.003	0.003
8a	0.043	0.005	0.004	0.001
8b	0.044	0.005	0.003	0.001
9a	0.046	0.003	0.000	0.004
9b	0.053	0.000	0.000	0.000
Subtotal	**0.819**	**0.065**	**0.045**	**0.071**
Total				**1.000**

Appendix G44. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z1, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.028	0.010	0.014	0.000
1b	0.032	0.005	0.006	0.010
2a	0.028	0.006	0.007	0.012
3a	0.039	0.004	0.006	0.003
3b	0.037	0.006	0.009	0.001
4a	0.036	0.006	0.008	0.002
4b	0.027	0.008	0.011	0.006
4c	0.033	0.003	0.015	0.001
4d	0.037	0.004	0.010	0.002
5a	0.034	0.004	0.009	0.006
5b	0.038	0.008	0.006	0.000
6a	0.036	0.005	0.007	0.005
6b	0.028	0.008	0.012	0.005
7a	0.032	0.004	0.009	0.007
7b	0.035	0.005	0.006	0.006
8a	0.037	0.008	0.006	0.002
8b	0.047	0.003	0.001	0.002
9a	0.031	0.011	0.007	0.004
9b	0.033	0.014	0.005	0.001
Subtotal	**0.649**	**0.122**	**0.156**	**0.073**
Total				**1.000**

Appendix G45. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z2, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.038	0.007	0.003	0.004
1b	0.031	0.006	0.007	0.008
2a	0.033	0.006	0.005	0.009
3a	0.042	0.005	0.004	0.003
3b	0.041	0.005	0.004	0.003
4a	0.037	0.004	0.006	0.005
4b	0.037	0.006	0.005	0.005
4c	0.038	0.005	0.007	0.003
4d	0.040	0.004	0.006	0.003
5a	0.032	0.005	0.005	0.011
5b	0.035	0.006	0.004	0.008
6a	0.034	0.007	0.003	0.009
6b	0.031	0.007	0.007	0.008
7a	0.037	0.004	0.006	0.006
7b	0.037	0.006	0.005	0.004
8a	0.039	0.004	0.006	0.003
8b	0.035	0.005	0.011	0.001
9a	0.040	0.005	0.005	0.003
9b	0.043	0.004	0.006	0.000
Subtotal	**0.699**	**0.102**	**0.104**	**0.095**
Total				**1.000**

Appendix G46. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z3, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.037	0.006	0.007	0.003
1b	0.036	0.007	0.003	0.007
2a	0.036	0.005	0.006	0.006
3a	0.042	0.004	0.005	0.002
3b	0.043	0.002	0.004	0.003
4a	0.040	0.006	0.004	0.003
4b	0.038	0.004	0.003	0.007
4c	0.036	0.007	0.007	0.002
4d	0.046	0.002	0.003	0.002
5a	0.037	0.002	0.004	0.009
5b	0.047	0.002	0.002	0.001
6a	0.038	0.006	0.003	0.006
6b	0.035	0.005	0.006	0.007
7a	0.039	0.004	0.003	0.007
7b	0.043	0.003	0.004	0.002
8a	0.042	0.003	0.007	0.002
8b	0.013	0.011	0.018	0.010
9a	0.042	0.003	0.004	0.005
9b	0.046	0.004	0.002	0.001
Subtotal	**0.737**	**0.084**	**0.095**	**0.084**
Total				**1.000**

Appendix G47. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z4, Grade-IX)

Topics	Remember3	Understand3	Skills3	STS3
1a	0.031	0.012	0.000	0.011
1b	0.032	0.011	0.010	0.000
2a	0.020	0.016	0.015	0.002
3a	0.029	0.015	0.007	0.002
3b	0.029	0.009	0.008	0.006
4a	0.024	0.016	0.012	0.001
4b	0.029	0.012	0.008	0.003
4c	0.026	0.006	0.014	0.006
4d	0.028	0.013	0.006	0.005
5a	0.035	0.007	0.009	0.001
5b	0.032	0.013	0.005	0.003
6a	0.037	0.008	0.006	0.002
6b	0.033	0.007	0.008	0.004
7a	0.031	0.007	0.010	0.005
7b	0.034	0.009	0.006	0.004
8a	0.035	0.008	0.007	0.002
8b	0.034	0.009	0.007	0.003
9a	0.031	0.006	0.008	0.007
9b	0.032	0.011	0.005	0.005
Subtotal	0.581	0.195	0.152	0.072
Total				**1.000**

Appendix G48. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W1, (Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.031	0.007	0.010	0.000
10b	0.022	0.006	0.017	0.002
11a	0.026	0.008	0.012	0.002
11b	0.025	0.009	0.012	0.001
12a	0.029	0.005	0.012	0.002
12b	0.028	0.007	0.012	0.000
12c	0.029	0.007	0.012	0.000
13a	0.025	0.009	0.014	0.000
13b	0.026	0.009	0.012	0.001
13c	0.032	0.002	0.012	0.001
14a	0.024	0.008	0.012	0.003
14b	0.026	0.008	0.013	0.000
14c	0.025	0.009	0.013	0.001
15a	0.027	0.010	0.011	0.000
15b	0.034	0.004	0.009	0.001
16a	0.032	0.008	0.005	0.003
16b	0.032	0.008	0.007	0.001
17a	0.037	0.004	0.005	0.001
17b	0.035	0.005	0.007	0.001
18a	0.042	0.002	0.002	0.001
18b	0.026	0.009	0.010	0.002
Subtotal	**0.613**	**0.143**	**0.219**	**0.026**
Total				**1.000**

Appendix G49. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W2, (Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.030	0.005	0.012	0.000
10b	0.025	0.011	0.009	0.002
11a	0.037	0.008	0.003	0.000
11b	0.031	0.012	0.003	0.001
12a	0.036	0.008	0.002	0.002
12b	0.030	0.004	0.013	0.000
12c	0.035	0.008	0.005	0.000
13a	0.041	0.004	0.002	0.000
13b	0.024	0.008	0.013	0.002
13c	0.039	0.005	0.003	0.000
14a	0.020	0.010	0.015	0.002
14b	0.028	0.007	0.012	0.000
14c	0.029	0.005	0.013	0.001
15a	0.032	0.009	0.007	0.000
15b	0.030	0.005	0.011	0.001
16a	0.031	0.008	0.006	0.003
16b	0.039	0.007	0.002	0.000
17a	0.036	0.010	0.002	0.000
17b	0.030	0.010	0.008	0.000
18a	0.033	0.010	0.002	0.002
18b	0.030	0.007	0.010	0.001
Subtotal	**0.667**	**0.159**	**0.156**	**0.019**
Total				**1.000**

Appendix G50. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W3 (Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.037	0.005	0.006	0.000
10b	0.041	0.003	0.004	0.000
11a	0.035	0.005	0.007	0.001
11b	0.039	0.004	0.005	0.000
12a	0.038	0.001	0.008	0.001
12b	0.036	0.004	0.007	0.001
12c	0.040	0.002	0.006	0.000
13a	0.035	0.003	0.009	0.001
13b	0.033	0.006	0.008	0.000
13c	0.037	0.005	0.004	0.001
14a	0.036	0.007	0.004	0.000
14b	0.034	0.009	0.005	0.000
14c	0.034	0.006	0.007	0.000
15a	0.034	0.007	0.006	0.000
15b	0.035	0.005	0.006	0.001
16a	0.034	0.009	0.004	0.001
16b	0.041	0.007	0.000	0.000
17a	0.041	0.006	0.000	0.000
17b	0.040	0.008	0.000	0.000
18a	0.041	0.005	0.000	0.001
18b	0.040	0.003	0.005	0.000
Subtotal	**0.781**	**0.108**	**0.100**	**0.011**
Total				**1.000**

Appendix G51. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (W4, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.022	0.009	0.016	0.001
10b	0.012	0.004	0.014	0.018
11a	0.030	0.013	0.004	0.000
11b	0.029	0.005	0.009	0.005
12a	0.022	0.009	0.011	0.005
12b	0.019	0.011	0.015	0.003
12c	0.024	0.009	0.006	0.009
13a	0.021	0.012	0.009	0.006
13b	0.034	0.005	0.008	0.000
13c	0.023	0.019	0.003	0.003
14a	0.026	0.010	0.008	0.004
14b	0.023	0.008	0.015	0.001
14c	0.020	0.011	0.013	0.003
15a	0.024	0.006	0.008	0.010
15b	0.015	0.009	0.010	0.014
16a	0.032	0.010	0.004	0.001
16b	0.021	0.012	0.006	0.008
17a	0.032	0.011	0.003	0.000
17b	0.025	0.011	0.000	0.011
18a	0.037	0.008	0.000	0.003
18b	0.028	0.015	0.000	0.004
Subtotal	**0.521**	**0.207**	**0.162**	**0.110**
Total				**1.000**

Appendix G52. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X1, Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.026	0.005	0.017	0.000
10b	0.028	0.008	0.009	0.002
11a	0.030	0.009	0.005	0.003
11b	0.034	0.006	0.008	0.000
12a	0.032	0.008	0.007	0.001
12b	0.031	0.005	0.009	0.002
12c	0.033	0.007	0.005	0.003
13a	0.034	0.004	0.008	0.001
13b	0.030	0.004	0.013	0.000
13c	0.026	0.008	0.011	0.003
14a	0.030	0.005	0.011	0.001
14b	0.033	0.002	0.010	0.001
14c	0.033	0.008	0.007	0.000
15a	0.028	0.005	0.012	0.002
15b	0.027	0.008	0.010	0.002
16a	0.029	0.008	0.009	0.002
16b	0.031	0.007	0.007	0.003
17a	0.035	0.004	0.006	0.002
17b	0.039	0.002	0.006	0.000
18a	0.043	0.003	0.000	0.001
18b	0.035	0.010	0.000	0.003
Subtotal	**0.668**	**0.126**	**0.171**	**0.035**
Total				**1.000**

Appendix G53. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X2, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.034	0.004	0.009	0.000
10b	0.030	0.008	0.008	0.002
11a	0.039	0.007	0.002	0.000
11b	0.033	0.004	0.009	0.002
12a	0.038	0.005	0.003	0.001
12b	0.034	0.003	0.009	0.001
12c	0.038	0.004	0.005	0.001
13a	0.041	0.004	0.001	0.001
13b	0.036	0.003	0.008	0.001
13c	0.033	0.008	0.006	0.000
14a	0.030	0.007	0.008	0.003
14b	0.031	0.003	0.012	0.001
14c	0.029	0.005	0.013	0.001
15a	0.035	0.005	0.007	0.000
15b	0.032	0.008	0.007	0.001
16a	0.034	0.007	0.006	0.000
16b	0.038	0.008	0.002	0.000
17a	0.038	0.008	0.002	0.000
17b	0.037	0.003	0.008	0.000
18a	0.040	0.002	0.002	0.003
18b	0.032	0.009	0.004	0.002
Subtotal	0.732	0.113	0.131	0.023
Total				**1.000**

Appendix G54. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X3, Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.036	0.003	0.009	0.000
10b	0.041	0.004	0.002	0.000
11a	0.037	0.005	0.004	0.001
11b	0.038	0.003	0.006	0.000
12a	0.040	0.002	0.004	0.001
12b	0.036	0.005	0.004	0.003
12c	0.041	0.002	0.004	0.000
13a	0.037	0.003	0.006	0.001
13b	0.040	0.003	0.004	0.000
13c	0.036	0.004	0.006	0.002
14a	0.038	0.006	0.003	0.000
14b	0.040	0.004	0.003	0.000
14c	0.037	0.005	0.005	0.001
15a	0.037	0.004	0.005	0.002
15b	0.039	0.003	0.006	0.000
16a	0.036	0.006	0.004	0.001
16b	0.043	0.004	0.000	0.000
17a	0.045	0.003	0.000	0.000
17b	0.043	0.004	0.000	0.000
18a	0.041	0.006	0.000	0.001
18b	0.042	0.002	0.003	0.000
Subtotal	**0.824**	**0.082**	**0.079**	**0.014**
Total				**1.000**

Appendix G55. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (X4, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.025	0.004	0.017	0.001
10b	0.023	0.004	0.008	0.012
11a	0.030	0.013	0.004	0.000
11b	0.030	0.006	0.008	0.004
12a	0.025	0.008	0.010	0.005
12b	0.025	0.009	0.010	0.004
12c	0.026	0.008	0.007	0.007
13a	0.035	0.005	0.004	0.004
13b	0.038	0.004	0.003	0.002
13c	0.023	0.012	0.010	0.002
14a	0.028	0.008	0.007	0.005
14b	0.038	0.003	0.006	0.000
14c	0.026	0.008	0.009	0.005
15a	0.032	0.006	0.007	0.003
15b	0.022	0.008	0.009	0.009
16a	0.034	0.009	0.003	0.001
16b	0.024	0.009	0.008	0.008
17a	0.035	0.007	0.006	0.000
17b	0.034	0.005	0.000	0.008
18a	0.044	0.003	0.000	0.001
18b	0.031	0.010	0.000	0.006
Subtotal	**0.630**	**0.149**	**0.135**	**0.086**
Total				**1.000**

Appendix G56. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y1, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.032	0.004	0.010	0.000
10b	0.033	0.008	0.006	0.001
11a	0.031	0.006	0.010	0.001
11b	0.036	0.003	0.007	0.001
12a	0.034	0.005	0.006	0.002
12b	0.033	0.006	0.008	0.001
12c	0.033	0.007	0.007	0.001
13a	0.031	0.005	0.008	0.003
13b	0.036	0.004	0.007	0.000
13c	0.034	0.008	0.005	0.001
14a	0.031	0.009	0.006	0.002
14b	0.037	0.002	0.008	0.000
14c	0.034	0.007	0.005	0.001
15a	0.031	0.005	0.008	0.003
15b	0.032	0.008	0.007	0.001
16a	0.034	0.007	0.005	0.001
16b	0.033	0.006	0.006	0.002
17a	0.037	0.006	0.004	0.001
17b	0.037	0.007	0.002	0.001
18a	0.042	0.002	0.002	0.001
18b	0.034	0.009	0.001	0.003
Subtotal	**0.718**	**0.125**	**0.127**	**0.031**
Total				**1.000**

Appendix G57. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y2, Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.036	0.005	0.006	0.000
10b	0.030	0.006	0.009	0.002
11a	0.042	0.003	0.003	0.000
11b	0.036	0.008	0.003	0.001
12a	0.038	0.006	0.002	0.002
12b	0.035	0.004	0.009	0.000
12c	0.035	0.008	0.005	0.000
13a	0.041	0.004	0.002	0.000
13b	0.033	0.003	0.009	0.002
13c	0.039	0.005	0.003	0.000
14a	0.038	0.005	0.003	0.002
14b	0.037	0.004	0.006	0.000
14c	0.034	0.005	0.008	0.001
15a	0.032	0.009	0.007	0.000
15b	0.030	0.005	0.011	0.001
16a	0.031	0.008	0.006	0.003
16b	0.039	0.007	0.002	0.000
17a	0.036	0.010	0.002	0.000
17b	0.030	0.010	0.008	0.000
18a	0.033	0.010	0.002	0.002
18b	0.030	0.007	0.010	0.001
Subtotal	**0.734**	**0.131**	**0.116**	**0.019**
Total				**1.000**

Appendix G58. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y3, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.039	0.005	0.004	0.000
10b	0.041	0.003	0.004	0.000
11a	0.038	0.004	0.005	0.001
11b	0.041	0.003	0.003	0.000
12a	0.039	0.002	0.006	0.001
12b	0.041	0.004	0.002	0.000
12c	0.044	0.002	0.000	0.001
13a	0.040	0.003	0.004	0.001
13b	0.042	0.002	0.003	0.000
13c	0.042	0.003	0.002	0.000
14a	0.048	0.000	0.000	0.000
14b	0.038	0.003	0.004	0.002
14c	0.039	0.004	0.003	0.002
15a	0.048	0.000	0.000	0.000
15b	0.048	0.000	0.000	0.000
16a	0.038	0.005	0.004	0.001
16b	0.040	0.007	0.000	0.001
17a	0.038	0.004	0.002	0.004
17b	0.035	0.010	0.001	0.001
18a	0.040	0.005	0.002	0.000
18b	0.043	0.002	0.003	0.000
Subtotal	**0.860**	**0.072**	**0.051**	**0.017**
Total				**1.000**

Appendix G59. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Y4, Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.026	0.008	0.013	0.001
10b	0.025	0.004	0.008	0.010
11a	0.032	0.011	0.004	0.001
11b	0.029	0.004	0.010	0.004
12a	0.026	0.007	0.010	0.004
12b	0.023	0.008	0.012	0.005
12c	0.027	0.007	0.007	0.006
13a	0.030	0.004	0.008	0.005
13b	0.032	0.008	0.006	0.002
13c	0.025	0.013	0.006	0.003
14a	0.032	0.007	0.005	0.004
14b	0.026	0.008	0.010	0.004
14c	0.033	0.007	0.005	0.003
15a	0.027	0.005	0.008	0.008
15b	0.023	0.009	0.009	0.007
16a	0.032	0.010	0.004	0.001
16b	0.022	0.011	0.008	0.006
17a	0.030	0.011	0.006	0.001
17b	0.028	0.007	0.000	0.013
18a	0.039	0.005	0.000	0.003
18b	0.024	0.014	0.000	0.009
Subtotal	**0.591**	**0.168**	**0.141**	**0.100**
Total				**1.000**

Appendix G60. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z1, Grade-X)

Topics	**Remember4**	**Understand4**	**Skills4**	**STS4**
10a	0.036	0.004	0.007	0.001
10b	0.023	0.006	0.012	0.006
11a	0.023	0.005	0.010	0.009
11b	0.030	0.003	0.011	0.004
12a	0.029	0.004	0.010	0.004
12b	0.031	0.004	0.010	0.003
12c	0.036	0.005	0.004	0.002
13a	0.031	0.003	0.009	0.004
13b	0.034	0.004	0.009	0.001
13c	0.035	0.006	0.004	0.002
14a	0.031	0.007	0.007	0.002
14b	0.029	0.001	0.013	0.004
14c	0.032	0.007	0.007	0.002
15a	0.034	0.004	0.002	0.007
15b	0.031	0.009	0.005	0.003
16a	0.035	0.006	0.005	0.001
16b	0.030	0.005	0.008	0.004
17a	0.030	0.004	0.007	0.007
17b	0.028	0.006	0.010	0.003
18a	0.030	0.002	0.006	0.010
18b	0.030	0.008	0.006	0.003
Subtotal	**0.649**	**0.103**	**0.165**	**0.084**
Total				**1.000**

Appendix G61. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z2, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.033	0.004	0.009	0.001
10b	0.028	0.011	0.005	0.003
11a	0.037	0.006	0.004	0.001
11b	0.037	0.004	0.005	0.001
12a	0.038	0.004	0.004	0.001
12b	0.036	0.004	0.004	0.003
12c	0.034	0.006	0.006	0.002
13a	0.037	0.003	0.005	0.002
13b	0.035	0.003	0.008	0.001
13c	0.030	0.005	0.010	0.002
14a	0.036	0.003	0.006	0.002
14b	0.038	0.003	0.006	0.001
14c	0.038	0.004	0.004	0.001
15a	0.039	0.004	0.004	0.001
15b	0.036	0.004	0.005	0.002
16a	0.036	0.005	0.005	0.001
16b	0.037	0.004	0.004	0.002
17a	0.034	0.005	0.004	0.004
17b	0.025	0.010	0.010	0.002
18a	0.029	0.011	0.006	0.001
18b	0.030	0.005	0.010	0.003
Subtotal	0.724	0.111	0.124	0.041
Total				**1.000**

Appendix G62. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z3, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.042	0.002	0.003	0.001
10b	0.038	0.003	0.004	0.002
11a	0.038	0.004	0.003	0.002
11b	0.039	0.002	0.004	0.002
12a	0.039	0.003	0.003	0.002
12b	0.040	0.002	0.003	0.003
12c	0.040	0.004	0.002	0.002
13a	0.040	0.003	0.003	0.002
13b	0.040	0.002	0.004	0.001
13c	0.048	0.000	0.000	0.000
14a	0.048	0.000	0.000	0.000
14b	0.037	0.001	0.001	0.008
14c	0.046	0.000	0.002	0.000
15a	0.044	0.000	0.004	0.000
15b	0.037	0.003	0.005	0.002
16a	0.040	0.003	0.004	0.001
16b	0.038	0.002	0.004	0.003
17a	0.040	0.004	0.004	0.000
17b	0.036	0.003	0.009	0.000
18a	0.040	0.001	0.005	0.001
18b	0.035	0.001	0.012	0.000
Subtotal	**0.841**	**0.045**	**0.079**	**0.035**
Total				**1.000**

Appendix G63. Fine Grain level SLO Ratios in Curriculum Taught by Teachers (Z4, Grade-X)

Topics	Remember4	Understand4	Skills4	STS4
10a	0.027	0.010	0.010	0.001
10b	0.018	0.004	0.013	0.012
11a	0.029	0.008	0.003	0.008
11b	0.032	0.005	0.007	0.004
12a	0.026	0.007	0.010	0.005
12b	0.028	0.008	0.009	0.004
12c	0.026	0.006	0.008	0.008
13a	0.029	0.008	0.007	0.004
13b	0.035	0.004	0.007	0.002
13c	0.024	0.014	0.006	0.003
14a	0.026	0.010	0.008	0.004
14b	0.024	0.008	0.012	0.003
14c	0.027	0.009	0.008	0.004
15a	0.025	0.005	0.009	0.008
15b	0.026	0.005	0.006	0.010
16a	0.033	0.008	0.005	0.002
16b	0.023	0.009	0.006	0.010
17a	0.028	0.010	0.005	0.004
17b	0.030	0.010	0.000	0.009
18a	0.039	0.007	0.000	0.002
18b	0.031	0.013	0.000	0.003
Subtotal	**0.587**	**0.165**	**0.139**	**0.110**
Total				**1.000**

Appendix- H

Inter-Rater Correlation Reliability Test

Reliability

Log

```
RELIABILITY
  /VARIABLES=VAR00001 VAR00002 VAR00004 VAR00003
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE
  /SUMMARY=TOTAL.
```

```
[DataSet0]
```

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	8	100.0
	Excluded[a]	0	.0
	Total	8	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.871	4

Item Statistics

	Mean	Std. Deviation	N
VAR00001	.6588	.02232	8
VAR00002	.6088	.02232	8
VAR00004	.7675	.03012	8
VAR00003	.5350	.02777	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
VAR00001	1.9113	.005	.590	.884
VAR00002	1.9613	.004	.908	.774
VAR00004	1.8025	.004	.623	.888
VAR00003	2.0350	.004	.849	.781

Appendix- I

SUMMARY OF ALIGNED AND MISALIGNED SLO (GRADE-IX)

Topic	Total SLO in the Written Curriculum	Textbook		Question Papers		Taught	
		Aligned	Not Aligned	Aligned	Not Aligned	Aligned	Not Aligned
1a	9	8	1	4	5	8	1
1b	8	5	3	3	5	6	2
2a	13	8	5	7	6	8	5
3a	25	16	9	6	19	14	11
3b	10	7	3	8	2	5	5
4a	10	8	2	9	1	8	2
4b	18	14	4	11	7	12	6
4c	11	7	4	9	2	7	4
4d	11	8	3	9	2	8	3
5a	15	8	7	7	8	8	7
5b	14	7	7	8	6	6	8
6a	14	7	7	6	8	7	7
6b	5	2	3	4	1	2	3
7a	17	9	8	9	8	8	9
7b	9	2	7	5	4	2	7
8a	24	12	12	13	11	12	12
8b	12	7	5	6	6	8	4
9a	19	12	7	8	11	10	9
9b	26	14	12	11	15	12	14
Total	**270**	**161**	**109**	**143**	**127**	**151**	**119**

Appendix- J

Summary of Aligned and Misaligned SLO (Grade-X)

Topic	Total SLO in the Written Curriculum	Textbook		Question Papers		Taught	
		Aligned	Not Aligned	Aligned	Not Aligned	Aligned	Not Aligned
10a	16	6	10	4	12	5	11
10b	9	7	2	4	5	6	3
11a	8	5	3	5	3	4	4
11b	22	16	6	11	11	10	12
12a	21	14	7	13	8	10	11
12b	12	8	4	6	6	8	4
12c	11	8	3	5	6	8	3
13a	8	4	4	5	3	4	4
13b	9	8	1	7	2	8	1
13c	4	1	3	2	2	1	3
14a	12	7	5	7	5	7	5
14b	11	9	2	6	5	9	2
14c	11	8	3	6	5	8	3
15a	13	9	4	7	6	9	4
15b	26	13	13	10	16	12	14
16a	14	9	5	8	6	9	5
16b	20	13	7	8	12	10	10
17a	10	7	3	6	4	7	3
17b	12	9	3	4	8	5	7
18a	12	8	4	6	6	5	7
18b	6	2	4	3	3	2	4
Total	**267**	**171**	**96**	**133**	**134**	**147**	**120**