UNIT 2 PERSPECTIVES OF DISCIPLINARY KNOWLEDG

Structure

2.1 INTRODUCTION

Understanding the perspectives of disciplinary knowledge is as important as understanding content of the subject for the teachers. Framing a discipline is not an independent task. As you know most disciplines are inter linked with each other. Therefore, teachers need to understand the way the disciplines are conceptualized and the perspectives that constitute to generate the knowledge in that discipline. In the previous Unit, you have learnt about the sources of acquiring knowledge, categorizing knowledge and constitution of disciplinary knowledge.

Keeping in view the above, we will explain the concept, nature and evolution of the disciplines. In the section on 'evolution and framing of disciplines', you will find specific descriptions which are given in framing the individual disciplines like, English, Mathematics, Physics, Social Sciences, and Humanities. The philosophical, socio-cultural and the historical perspectives of evolution and framing of the disciplines have also been discussed in this Unit. Apart from these, the inter-relationships between and among the disciplines taught at the school level have also been discussed.

2.2 OBJECTIVES

After going through this Unit, you will be able to:

- explain the concept of discipline specific knowledge;
- discuss the evolution and framing of disciplines;
- critically analyse various perspectives of evolution of disciplines; and
- establish relationships between and among various disciplines.

2.3 DISCIPLINE SPECIFIC KNOWLEDGE

Discipline specific knowledge can be defined as a set of understandings that are more than broad knowledge of a field, rather, it is the sort of knowledge that is specific to the discipline or profession (Koehler, 2012). The discipline specific knowledge in the discipline of 'Science' is more or less different than the discipline specific knowledge of the discipline 'Languages' and so as with 'Mathematics' and 'Social Sciences'. It is based upon the aims and objectives of studying the specific disciplines and also the nature of the discipline. The processes of acquiring knowledge in the 'Science' discipline like; scientific inquiry, experiment, scientific exploration, discovery, problem-solving, etc. may not be the same with disciplines of 'Social Sciences' or 'Languages'. In 'Social Sciences', we deal mostly with the social issues and involve ourselves in observations, social surveys, social inquiry, social explorations, interviews, narrations, anecdotes, case analysis, and reflections on happenings, events and ideas.

Each discipline has a way of looking at the world that influences how research and teaching within that discipline are pursued. Only in recent decades the key features of the discipline have been identified. These are:

- Disciplines identify certain things that they study, like the discipline of Social Sciences are engaged with exploring the social realities and establishing relationships within the social groups, communities, institutions, families, and also individuals.
- Disciplinary knowledge comprises a few theories, like the discipline of Science consists of knowledge about theory of 'Gravity', theory of 'Relativity' etc.
- Disciplinary knowledge is transacted through a few methods, like knowledge in discipline of Science is transacted through the method of experiments and scientific inquiry whereas knowledge in discipline of 'Social Sciences' is transacted through the methods like social inquiry, narration cum discussion, strong telling, etc.
- Key concepts in a discipline are defined according to the nature of the discipline. The concepts in Science are defined from scientific perspectives; the concepts in Social Sciences are defined from socio-political perspectives; whereas the concepts in psychology are defined from psychological perspective.
- Disciplines take their own ontological stance toward the nature of reality, like the discipline of 'Philosophy' defines the world from a metaphysical perspective, the 'Religion Studies' perceives the world from a spiritual perspective, whereas the discipline of 'Science' takes the world as a material reality.

- Disciplines take their own epistemological stance regarding the possibilities of human understanding, like all disciplines have their own epistemological bases as well as their own ways of validating the knowledge. For example, method of validating knowledge in 'Science' is different from that of 'Philosophy'.
- Disciplines, to varying degrees, may also be associated with particular ethical, ideological, or aesthetic practices, like the discipline of 'Science' is having certain ethical practices and the same is with the discipline of 'Social Sciences'.
- Disciplines are identified with some major thinkers, and followers, like the major thinkers of the discipline of 'Philosophy' are Plato, Aristotle, Kant, Socrates, and Karl Marx whereas the thinkers of the discipline of 'Science' are Einstein, Newton, Copernicus, Galileo, and Darwin.

Activity 1

As per your understanding, add a few more features to the discipline as discussed above.

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In the section 1.6 of Unit-1 of this Block, you have studied the categorization of knowledge for constituting a discipline (Table 1.1). On the basis of the above descriptions as well as categorization of knowledge for constituting a discipline (section 1.6, Unit-1), we present the discipline specific processes to acquire knowledge of major disciplines as follows:

Table 2.1: Major disciplines with discipline specific processes to acquire knowledge

Major Disciplines	Discipline Specific Processes to acquire Knowledge
Science	• Critical observation of the natural phenomenon • Developing inquiry on observable phenomenon • Establishing linking and correlating the scientific ideas with physical happenings

	• Engaging in scientific experimentation • Natural and scientific exploration of facts and ideas and their validation • Validating the result of scientific inquiry • Developing scientific thinking and ability to make abstract concepts/ideas
Social Sciences	• Critical observation of the social phenomenon, like social happenings; norms of the society; inter-personal relationships; issues pertaining to the society; changes and dynamics of the society; diversities and inclusiveness; understanding gender, caste and class, culture and religion; etc. • Engaging in social inquiry, exploration, and understanding cross cultural and cross sectional dimensions of the society • Understanding social, cultural, and economic diversities of the society • Understanding individual's rights and duties • Understanding civic responsibilities, ethical practices, and love for the entire world
Mathematics	• Connecting mathematical principles with the daily life of the children • Making children think rationally, and do thing inductively or deductively • Developing logical reasoning and make the children to solve mathematical problems • Developing the skills of analyzing and synthesizing the mathematical principles
Languages	• Making the children communicate themselves in different situations • Developing the skills of listening, speaking, reading and writing • Understanding and reflecting on literature • Appreciating literature and engaging in creating literature • Linking similar literatures and also developing meta-cognitive skills

Four broad disciplines have been discussed in Table 2.1 with their processes to acquire discipline specific knowledge. Accordingly, discipline specific knowledge can be identified with other disciplines included in the curriculum taught at universities/schools.

Check Your Progress 1

Notes: a) Write your answer in the space given below.

b) Compare your answers with the ones that are given at the end of the unit.

1. Define discipline specific knowledge.

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2. Explain discipline specific processes to acquire knowledge in the discipline 'Science'.

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2.4 EVOLUTION AND FRAMING OF DISCIPLINES

Based upon the broad areas of knowledge, specific disciplines have evolved. All disciplines have their own history and evolution. In this section, the evolution of the disciplines taught at the universities and schools and how they have been framed are discussed:

2.4.1 Discipline of English

English as a discipline deals with the fundamental issues of human existence – realizing the essence of life and living; developing a sense of beauty and tolerance; engaging individuals in inter-personal relationships; making people express their sufferings, pains, pleasure, and adventures; appreciating the literary creation of others and also making the individuals create new literatures; and also spreading the essential values for living.

The evolution/history of 'English as a Discipline' is quite old. In the beginning, English language was the family language of the Indo-European people of West German. If we divide the history of English language, it can be divided into three main periods: 'Old English', 'Middle English' and 'Modern English'. It is observed that over the centuries, the language English has been influenced by many other languages. Let us try to understand the development of English language as mentioned in the Figure 2.1.

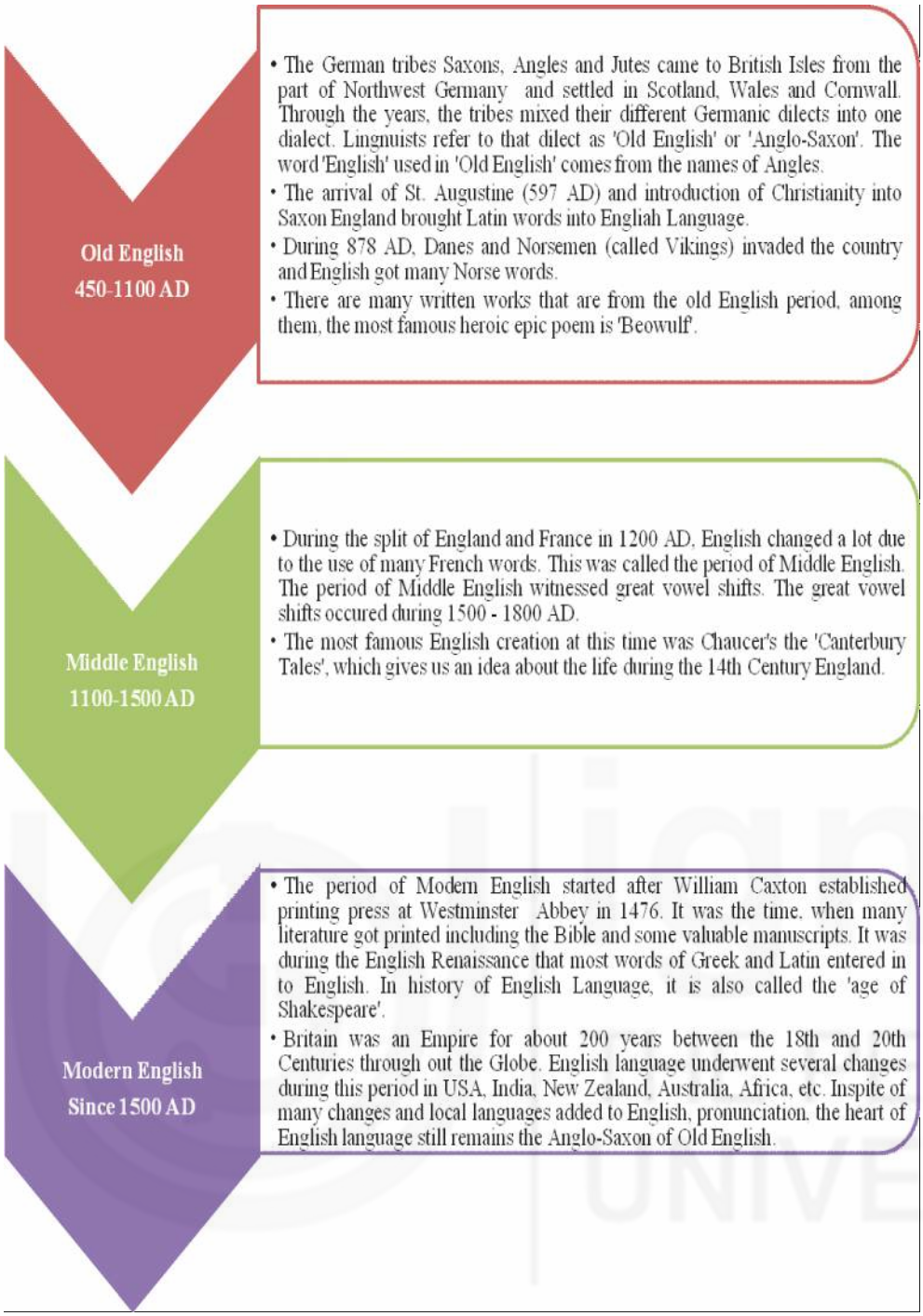

Figure 2.1 : History of English Language

*[**Source:** Boyanova, M. (2002), A Brief History of the English Language, retrieved from http://www.studyenglishtoday.net/english-language-history.html on 15.09.2016]*

The above development of English as a discipline makes us understand how languages survive over the centuries. At the present time, English is taught as a discipline in the university curriculum as well as it is taught as a compulsory subject in school education. The literary, non-literary, narrative, expository, technical, persuasive, and literary discourse texts are taught in School curriculum.

2.4.2 Discipline of Science

Like the discipline of English language, the discipline of Science has its own history and evolution. Over the years, the discipline of Science has been more

popular at university and school levels. Due to development of Science and Technology and findings of many fundamental researches in science, different new branches of science studies have evolved. In this section, we discuss development of different branches of Science and their evolution.

As you know, the body of knowledge included in Science is all about theoretical and practical knowledge about the natural world. Most branches of knowledge/ studies have evolved from the parent discipline of 'Philosophy'. Earlier, the philosophers investigating nature were called as 'natural philosophers', whereas empirical investigations of the natural world were described as 'classical antiquity' (For example, the works by Thales, Aristotle, and others). During the middle age, rigorous scientific methods have been employed in Science discipline (For example, the works of Ibn al-Haytham and Roger Bacon). The real scientific revolution took place in Europe during the 16th and 17th century. From the 18th century to the late 20th century, significant works in physical as well as biological sciences have taken place. Let us now discuss the specific disciplinary areas of Science.

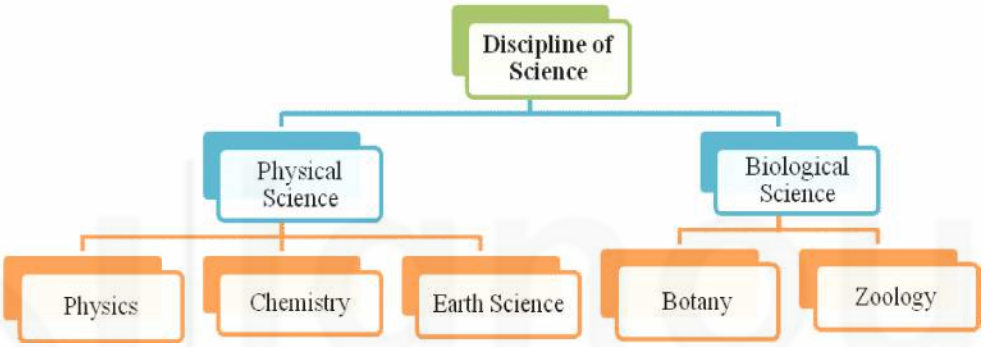

Figure 2.2 : Branches of Discipline of Science

The Figure 2.2 highlights the basic disciplines of Science. Of late, many sub-disciplines of different disciplines of Science have also emerged and are being taught in universities across the globe. Let us have a look at disciplines of Science and their sub-disciplines.

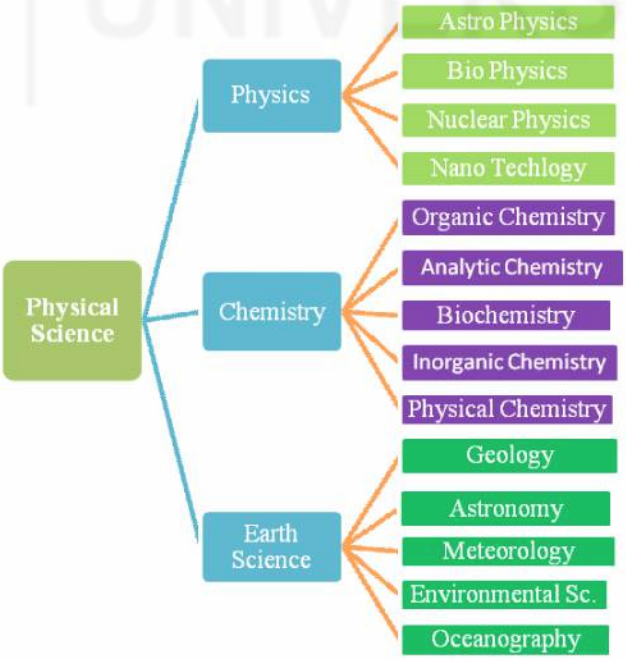

Figure 2.3 : Sub-disciplines of Physical Science

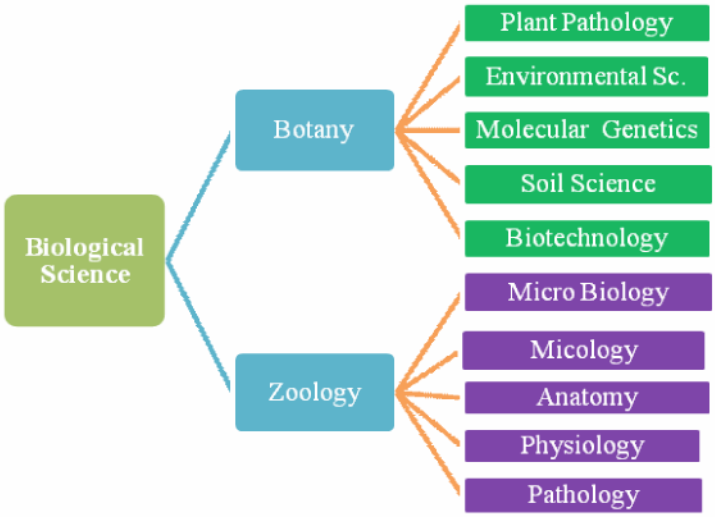

Figure 2.4 : Sub-disciplines of Biological Science

From the Figures 2.3 and 2.4, it is evident that the disciplines of Physical and Biological Sciences have further been divided into many sub-disciplines. The sub-disciplines of Physical and Biological Sciences have not evolved haphazardly, rather they have evolved with substantial knowledge base and of late, these special and applied sub-disciplines are becoming more popular areas of studies. Keeping in view the importance of the applied branches of Science, these are also included in school curriculum to acquaint the learners with the specialized areas of studies.

2.4.3 Discipline of Mathematics

Mathematics is considered as a human and cultural endeavour. Mathematical ideas develop everywhere because people may live in different cultures, but they do similar things. As quoted by Panda (2006), six operations which people engage across all cultures are counting, measuring, designing, locating, playing and explaining.

These activities involve an enormous amount of Mathematics. In fact, mathematical understanding is culturally conditioned and created across cultural contexts. There is a rich history of human development of mathematics and mathematical uses in our modern society. (Panda, 2006)

Mathematics as a discipline or field of study includes conceptual understanding and study about numbers, operations and theorems. The study of Mathematics can also be used as a tool for understanding other disciplines. The knowledge of Mathematics is highly used for developing logical reasoning, creativity and doing the practical works. The study of Mathematics touches human mind and life because we use mathematical calculations in our daily life. This can also be used for intellectual challenge which the professionals of Mathematics usually encounter. Professionals like engineers and technocrats always apply Mathematics in their own works. Since Mathematics plays a central role in modern culture, some basic understanding of the nature of Mathematics is required for scientific literacy. There is a need to understand Mathematics as part of the scientific and human endeavor. Mathematics is a broad discipline that has applications in other disciplines.

2.4.4 Discipline of Social Sciences

The history of the discipline of Social Sciences are as old as other disciplines. Discipline of Social Sciences are always an important area of studies for the

scholars as it touches the life of the people and their living in the community. The discipline of Social Science includes varieties of subject areas (also called disciplines) like History, Economics, Political Science, Sociology, Anthropology, Psychology, and Geography. The disciplines of the Social Science though address different issues relating to society, still the process of conceptualizing knowledge, applying it in social context, using methods and techniques to transact learning experiences and conducting research differ from one discipline of Social Science to other. They have also different and unique disciplinary identities and definitions to understand. Each discipline of Social Sciences satisfies the characteristics of a discipline. They have their own body of knowledge, group of academic practitioners/ followers, and also have their own history. The disciplines of Social Science are also called as the discipline of Humanities. Let us discuss the evolution of different disciplines of Social Science and major concepts they deal with.

Table 2.2 : Evolution of the disciplines of Social Science

Discipline(s)	**Evolution**
History	**[Period of Prehistory]** ▪ Events starting from the formation of the universe ▪ Events starting from formation of planet to the rise of modern human ▪ Events starting from the first appearance of Home sapiens to before the invention of writing **[Period of History]** ▪ Ancient History [3200 BC to 500 AD] ▪ Middle Ages [500 to 1499 AD] ▪ Early Modern History [1500 to 1900 AD] ▪ Modern History [1900 AD onwards]
Sociology	▪ A scientific study of all forms of human social life ▪ Sociology evolved as an academic discipline of study emphasizing: - people with various social characteristics - the ways of different types of relationships in the society - interaction in and through groups - various spatial/physical locations and time frame - an array of institutions - societal-level entities and the world system ▪ It also evolved as a discipline in order to understand modernity and particularly to study the modern societies and tracking their changing characteristics. *(**Source:** Charles Crothers,2010, The Historical Development of Sociology: Sociological Traditions. retrieved from http://www.eolss.net/sample-chapters/c04/e6-99a.pdf on 16.09.2016).*

Political Science	▪ The historical journey of the discipline of Political Science continues from the foundations of ancient theorists to the contemporary political scientists. ▪ The ancient Greek thinkers (Plato and Aristotle) had laid the foundation to politics as one of the systematic science of study. ▪ Further the Christian thinkers like St. Augustine and St. Thomas Aquinas had also dwelt upon the ideas of ideal State. ▪ During the fifteen century, the Italian Political thinker, Niccolo Machiavelli established the tradition of studying the historical as well as the existing political institutions. ▪ The work of Francis Lieber (Civil Liberty and Self Government) has made significant development for the growth of Political Science as an academic discipline. ▪ The contribution of 'Political Science Quarterly', one of the Journal published by the Faculty of Political Science, Culumbia University (considered as the first scholarly journal of Political Science) in 1886 had provided a platform to the political scientists to express their views on the contemporary political developments and issues. ▪ The establishment of 'American Political Science Association' in 1903 had also equally contributed to establishing Political Science as a discipline. ▪ By 1920s, a great paradigm shift occurred in the discipline of Political Science as because the positivist movements. New methods and ways of studying Political Science due to empirical and statistical techniques to conduct research in Political Science were introduced. ▪ After the Second World War and early fifties, Political Science got closely associated with Sociology as both had the common issues to deal with but they remained as independent disciplines of study with multi-disciplinary perspectives and understanding. ▪ Though the history of Political Science as a discipline is not so old but it is as an important discipline of study at university as well as in schools. (Source: KKHSOU, 2011)

Geography	▪ The term 'Geography' was first coined by Eratosthenes, a Greek scholar (276-194 BC). The ancient Greek scholars first systematically studied Geography. ▪ The tales of Miletus, Herodotus, Eratosthenes, Aristotle, Strabo, and Ptolemy had contributed a lot to Geography.

- The contributions of Romans for exploration and mapping of the unknown lands were also equally significant for understanding Geography.
- The journey of Marco Polo during the Middle Age arose interest among the scholars of geography.
- The introduction of textbooks and geographical maps during the 16th and 17th centuries had sensitized the scholars about sound theories of geography.
- During the 18th century, geography was recognized as a discipline of study at university level.
- The modern period of Geography started during the end of the 18th century with the works of Alexander von Humboldt and Karl Ritter.
- Since the end of World War II, Geography was well recognized as a popular discipline of study catering to the important content elements such as: aerial photography, remote sensors, satellite photography, and quantitative analysis and mapping through computers.
- During 1950s, the use of quantitative methods in conducting geographical research gained much popularity among the Geography scholars.
- Today, Geography is studied in universities as well as schools across the globe and is established as a unique discipline carrying the common characteristics of Science and Social Science.

(Source: The Columbia Electronic Encyclopedia, 2012)

Activity 2

Like the evolution of different disciplines of Social Sciences, write how the discipline of 'Economics' has evolved and is recognized as a disciplinary study.

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Check Your Progress 2

Notes: a) Write your answer in the space given below.

b) Compare your answers with the ones that are given at the end of the unit.

3. Explain the concept of 'Modern English'.

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4. Example the nature of contents which are included in the discipline of 'Earth Science'.

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5. Explain Mathematics as a human endeavour with an example.

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6. When did the evolution of the discipline of 'Political Science' take place?

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2.5 PERSPECTIVES OF DISCIPLINES

The evolution of a discipline is a continuous process. A discipline is formed with certain perspectives. We need to understand those perspectives in order to have a comprehensive understanding of a discipline and its nature. In this section, we discuss the perspectives of a discipline which contribute to its formation.

2.5.1 Philosophical Perspective

Every discipline has its own philosophy. You might be familiar with the terms: 'Philosophy of Science'; 'Philosophy of Social Science'; 'Philosophy of Mathematics'; and 'Philosophy of Language'. What do they mean? Do they mean

the knowledge base of those disciplines? Do they discuss the details of the contents in those disciplines? Such questions provide answers which explain the philosophical perspectives of a discipline. Let us try to get the answer to the above questions.

When we explain philosophy of Science, we explain the types of knowledge it deals with and the processes involved in acquiring those knowledge. For example; Science deals with empiricism, logical positivism, observations, the processes of inquiry and experimentation to validate the empirical findings. The above knowledge and processes form the discipline of Science. Such knowledge and processes can also be used in teaching different contents in Science. For example, to teach 'Germination', school children may be taught to observe how germination takes place? They can learn it by conducting an experiment with a seed.

Like Science, the discipline of Social Science is also based upon certain ideas and philosophy. Social Science involves processes like social observation, understanding inter-personal relationships, critically analysing the socio-political and economic issues, etc. The processes of acquiring scientific knowledge are different from the processes of acquiring Social Science knowledge. We can teach socio-political issues by organising debates, discussions, role plays, and critically analysing the issues. They can also be taught through social inquiry and critical observations.

Similarly, the processes of acquiring knowledge in Mathematics and Language are also different. Mathematics solves the problems by using inductive or deductive methods. It also uses the knowledge and processes of analysis to solve the problems. Mathematics helps us to deal with the numbers and calculations which we face in our day to day life. Language helps children acquire the skills of listening, reading, writing and speaking. They also develop within the children a sense of understanding literature, appreciating as well as creating new literature.

To conclude, it can be said that every discipline has its own philosophy and the process of acquiring knowledge. It is therefore, important to know the disciplinary knowledge of various disciplines.

2.5.2 Socio-political and Cultural Perspectives

Education is closely related to the society, its norms and principles, traditions and cultures and ways of living. All these contribute to the formation of academic discipline. Academic discipline can not be formed without the socio-cultural and political practices. Many a times, socio cultural practices form the part of our school curriculum. The goals of education are based upon the goals of the socio-political system of the country. National Policy on Education (1986) says:

> '*every country develops its system of education to express and promote its unique socio-cultural identity and also to meet the challenges of the time. There are moments in History when a new direction has to be given to an age-old process. That moment is today. Education is the highway to realize the cultural as well as socio-political goals of the country.'*

It is, therefore, you might have observed the following in Indian education system:

- We have a common educational structure starting from school to higher education.

- The national system of education is based on a national curriculum framework.
- National integration, international understanding and universal brotherhood are the basic principles of our education system.
- Issues of diversity, equity and equality form the essence of our education system.
- Further the socio-political and economic issues have also been included in various disciplines/school subjects.

The above features though broadly characterize the education system of our country, they also constitute the socio-cultural perspectives of forming the disciplines. The political ideologies of various political parties influence the education system of country and also contribute to formation of academic disciplines. Many a times, it is observed that certain contents/subjects are included or deleted from the broad curriculum or discipline because of ideologies and visions of the political party forming the government. So it can be said that the political perspective is also important for formation of the disciplines.

2.5.3 Historical Perspective

Like any other social phenomena, academic disciplines do have a history. Every discipline can be analysed by looking at its historical development (Kenneth, 1974). The journey of the specific academic discipline starting from its inception to the present form and practices of the discipline is called the history and development of that discipline. In the previous section (2.4), we got an idea about the evolution of various academic disciplines. The evolution of a discipline reflects the historical perspective of that discipline. A historian of Science or Social Science, or the Humanities narrates the specific historical contexts that have led to formation of that discipline. You might be knowing that most disciplines, which are taught in universities as well as colleges had, in fact, evolved from the parent discipline of 'Philosophy'. Historically, Philosophy subsumed all bodies of knowledge. Disciplines of 'Astronomy', 'Medicine', 'Physics', 'Mathematics', 'Psychology', 'Sociology', 'Education', 'Linguistics', 'Economics' etc. evolved from philosophy. The historical perspective of the discipline not only discusses the history of the development of the discipline but also describes the contexts in which it has evolved.

The changing need of the society, development of science and technology, emergence of new ways and techniques are certain conditions for emergence of new disciplines. For example, Social Science discipline evolved because of the political need of getting more information on the population, which could be used for effective government and stabilizing emerging social and political structure. Similarly, the discipline, 'Area Studies' emerged in USA during the second world war aiming to train the area specialists. Accordingly, evolution of the discipline of 'Computer Science' took place because of its link with the military applications at that time (Paleeri, 2015). We all know that 'History' is a discipline, which has its own background as an academic discipline. But in due course of time, the new sub-disciplines like, 'Ancient History', 'Medieval History' etc. have also emerged.

The above discussion emphasizes that the evolution of any discipline has certain historical perspective. The historical perspective of any discipline is also based upon the contexts prevailing at that time when it evolved.

Check Your Progress 3

Notes: a) Write your answer in the space given below.

b) Compare your answers with the ones that are given at the end of the unit.

7. Explain philosophical perspective of a discipline with an example.

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8. Explain the concept of socio-cultural perspective of a discipline.

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9. Explain, with an example, the historical perspective of a discipline.

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2.6 INTER-RELATIONSHIPS BETWEEN AND AMONG DISCIPLINES

The objectives of teaching-learning process can only be realized if contents of a discipline are taught with linkages within and between the disciplines. In school, Social Science cannot be taught independent of Science. Similarly, Language cannot be taught without integrating with Mathematics. We are proceeding towards the multi-disciplinary and trans-disciplinary approaches to curriculum organization and pedagogical practices. The knowledge of basics of Science, Mathematics, Social Science, as well as Language is important for the teachers to teach a discipline irrespective of the disciplines they belong to. It is therefore, important to understand the inter-relationships between and among the disciplines.

2.6.1 Inter-relationships between the Disciplines of Social Sciences

As we know, Social Science comprises the disciplines of History, Political Science, Economics, Geography, Sociology, etc. To teach Social Science, a teacher needs to understand the linkage among the disciplines of Social Science. For example, when we teach History of a particular time, we need to teach the socio-economic conditions of the people during that time, their socio-geographical diversities, system of governance within the community, language that they spoke, etc.

Moreover, to teach the disciplines of Social Science, teachers need to understand the relevant concepts of Science and Mathematics. For example, to teach 'Economics', teachers need to understand calculation, use of various figures/ graphs, use of statistics for data analysis and interpretation. While teaching 'Geography', teachers deal with the contents like population parameters, weather report, climate change, rain fall, demographic dividends, measurement of distance etc. All these need understanding of Mathematics, Science, as well as Statistics. Again the knowledge of Language is also very much important to understand various themes of Social Science. Language plays an important role in teaching various disciplines of Social Science. So to conclude, the disciplines of Social Science are inter-related with each other and also related with other disciplines of Science, Mathematics, and Language.

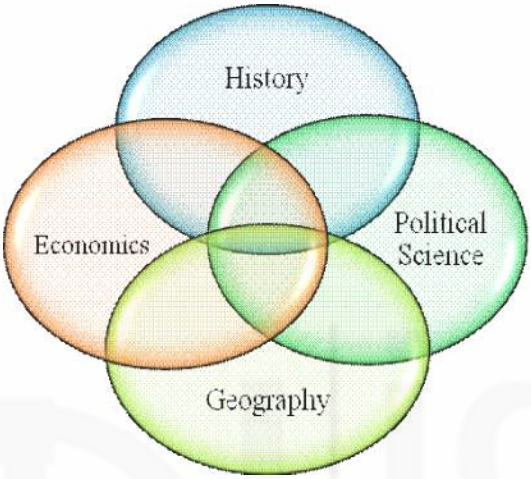

Figure 2.5 : Interrelationships of Social Sciences within the discipline

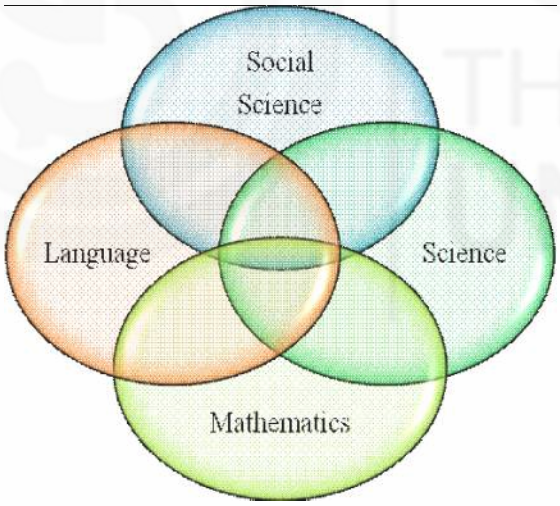

Figure 2.6 : Interrelationships of Social Sciences among the disciplines

Within the discipline, different branches of Social Science are related with each other, whereas, Social Science is also related with other disciplines such as Mathematics, Language and Science.

2.6.2 Inter-relationships of Language with other Disciplines

Language learning is always important for academic as well as other related works. The need of learning language is not only limited to that language but also extends to teaching of other disciplines or subjects. A teacher of Physics can only be an effective teacher if he/she uses discipline specific language to teach Physics.

Accordingly, a teacher from any discipline needs to know the specific terminologies and language used in other disciplines. Unless a teacher has mastery over the language and skills of using language across the curriculum, he/she can not be an effective teacher. Language is as important as content to connect discipline to discipline and subject to subject. For example, one needs to understand Mathematics for teaching English and vice versa. You will learn more about the functions of language Across the Curriculum in the course BES-124 'Language Across the Curriculum'. The linkage of language across the curriculum can be shown as follows:

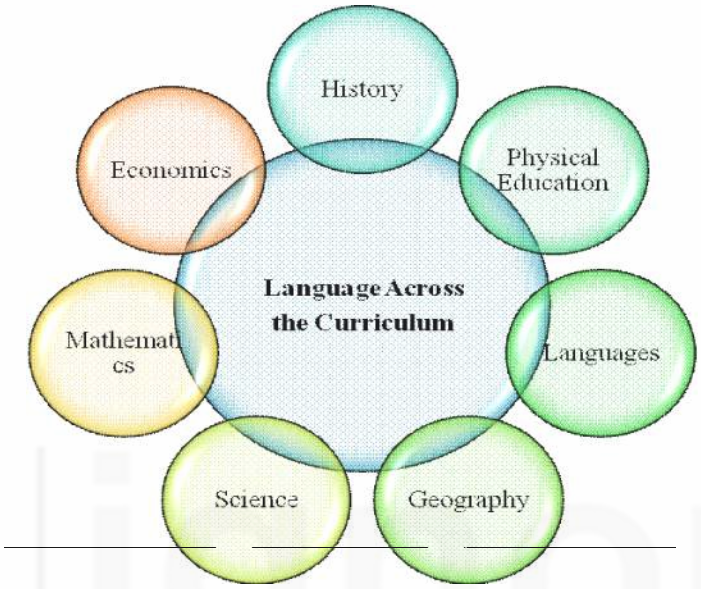

Figure 2.7 : Language Across the Curriculum

Activity 3

Referring to the Figure 2.7, explain with an example, how does language function across the curriculum?

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2.6.3 Inter-relationships between Physics and Mathematics

We often discuss about the close relationship between Physics and Mathematics. Without Mathematics no physics related problems in Physics can be solved. Similarly, to measure objects, distance, and to show relationships between different functions and properties in Physics, knowledge of Arithmetic, Algebra and advanced Mathematics can be used. Teachers and students often consider that the knowledge of Physics is difficult and complex. However, learning Physics can be made easy,

simple and interesting with the application of mathematical knowledge. It is often called the language of Physics is the Mathematics

Let us understand it with an illustration:

Connection of Einstein's general Theory of Relativity with the discipline of Mathematics

For eight years Einstein did nothing but tinker with Newton's theory of Gravity. He had many brilliant insights, but the structure of what he put together was very messy mathematically. There was no tidy way to put down in equations the essential meaning of his new ideas. Then he talked to an old classmate who had taken notes for him in Mathematics Class. Einstein explained his new hypothesis about gravity and asked the fellow if he had any ideas about how to structure gravity more clearly mathematically. His friend told him about a discipline of Mathematics that had been discovered while they had both been in School – tensor calculus and matrix mechanics in linear algebra. When he heard this, Einstein spent a lot of time slapping himself in the head. This Mathematics was not only elegant and beautiful, but it took the untidy equations Einstein had formulated and put them in a structure that was compact, showed relationships easily, and brought elegance and easy of understanding to what later became known as Einstein's General Theory of Relativity. Einstein's General Theory of Relativity boils down to this one equation in the language of tensor calculus.

$$G^{\mu\nu} = \kappa T^{\mu\nu}$$

Einstein later said that had he attended his math classes in school, he would have heard of these new mathematical disciplines, and instead of his theory taking eight years to develop, it would have taken him only three years at most.

*(**Source:** Retrieved from http://ww2.valdosta.edu/~cbarnbau/phys_math/p1_grel.html on 28.09.2016)*

All the formulas/principles of Mathematics are, to a great extent, used in Physics. For example, the principles/formulas of Mathematics like Calculus (single and multivariable), Differential Equations, Methods of Approximation and Probability are used in Physics. Mathematics is not only interrelated with Physics, it is also related to other disciplines like Languages, Social Science and other branches of Science.

2.6.4 Inter-relationships between Biology and Chemistry

Like the inter-relationships between Physics and Mathematics, the disciplines of Biological Sciences (Zoology and Botany) are closely related with Chemistry. You might have been familiar with the new discipline i.e. 'Biochemistry'. The knowledge base of Biochemistry has been generated from the disciplines of Biology and Chemistry. The discipline of Biochemistry explains how chemical reactions are effectively used to understand the complexity of the content of Biology. Biochemistry also explores the chemical processes involved in living organisms. It is a laboratory based Science discipline which brings together the disciplines of Biology and Chemistry. The Biochemists understand and solve the biological problems using chemical knowledge and techniques.

From the above discussion, you might have understood that no discipline is independent, rather there is a very close relationship within and among the disciplines. Hence, it is important for the teacher to understand the basics of the disciplines and linkage of knowledge across the disciplines. The objectives of teaching can only be realized when we teach subjects from inter and multi-disciplinary perspectives.

Activity 4

Define the discipline of 'Mycology'? Explain, with an example, how the study of Mycology addresses the disciplines of Biology and Chemistry.

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Check Your Progress 4

Notes: a) Write your answer in the space given below.

b) Compare your answers with the ones that are given at the end of the unit.

10. Explain the inter-relationship of Social Sciences with Mathematics.

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11. How language works across the curriculum?

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12. Explain the relationship of Mathematics with Physics.

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2.7 LET US SUM UP

The Unit, 'Perspectives of Disciplinary Knowledge', is designed to acquaint you with the evolution of various disciplines taught at school level with different perspectives contributing to their formation and evolution. To acquaint you with the development of disciplines and its inter-relationship nature of disciplinary knowledge, a thorough discussion has been made with necessary illustrations. The nature and scope of various disciplines with their perspectives have also been discussed in this Unit with elaboration.

Teaching school subjects using multi and trans-disciplinary approaches is a big challenge for the teachers. It is, therefore, necessary on the part of the teachers to understand the disciplinary perspectives of education. To make the disciplines inter-linked and inter-related with other disciplines, a thorough discussion has been made in this Unit.

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2.9 ANSWERS TO CHECK YOUR PROGRESS

1. Discipline specific knowledge can be defined as a set of understandings that are more than broad knowledge of a field, rather, it is the sort of knowledge that is specific to the discipline or profession.
2. Discipline specific processes to acquire knowledge in the discipline of Science includes observation, inquiry, experimentation, empiricism and positivism knowledge.
3. The concept of Modern English started after William Caxton established printing press at Westminster Abbey in 1476. It was the time, when many literatures got printed including the Bible and some valuable manuscripts. It was during the English Renaissance that most words of Greek and Latin entered in to English.
4. The nature of contents included in 'Earth Science' are Geology, Astronomy, Meterology, Environmental Science and Oceanology.
5. Mathematics is considered as a human and cultural endeavour because Mathematical ideas develop everywhere because people may live in different cultures, but they do similar things. Put example of your own.
6. The ancient Greek thinkers (Plato and Aristotle) had laid the foundation to politics as one of the systematic science of study. The evolution of the discipline of Political Science is considered starting from that time.
7. Every discipline has a philosophy and that determine the frame of knowledge of that discipline. The philosophy of science discipline is based upon empiricism, scientific inquiry, and scientific observation whereas the philosophy of Social Science discipline is based upon social inquiry, survey, social observation etc.
8. The societal practices, cultural heritage, and tradition of a society reflect in the academic discipline and school curriculum. Discipline is not beyond the society. It is therefore, academic disciplines are certainly have a socio-cultural perspective.
9. All disciplines have a history and have also certain conditions for its development. That's why, historical perspective of academic discipline is always an inherent component of each and every discipline.
10. To understand the technical concept of Social Science we need to understand the concept of Mathematics. As example, to understand Geographical concepts, Economics, Population Studies, etc. we use the Mathematical concepts calculations, figures/graphs, statistics for data analysis etc.
11. Language helps us to understand the contents and its meaning of different disciplines. Language is not only limited to study languages but also the knowledge of language works to make us understand across the disciplines.
12. All the calculations, derivations, equations, and theorizations in Physics are done by Mathematics. It is rightly said that the language uses in Physics is the Mathematics. It is therefore Physics and Mathematics are inter-related with each other.